AMATEUR WORK

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A HIGH SPEED LAUNCH.

CARL H. CLARK.

The small launch described in the present article is of the extreme speed launch type and is intended primarily for use on sheltered waters, such as lakes or rivers. With skilful handling, however, the boat will stand a considerable sea, but is hardly to be recommended for use upon other than quiet waters. It should appeal very strongly to those who are fond of canoeing, offering, as it does, a type of boat very similar to a canoe, but with far greater speed and endurance qualities.

general shape is not unlike a canoe except for the increased size and the full stern above water.

The general dimensions are:

Length on top	19′	6″
Length on water line	19′	0″
Beam at deck	3′	4″
Draft as designed	0′	6″

The actual draft of the boat will, of course, depend upon the lightness of construction and upon the weight of the crew carried, but this draft should easily

TABLE OF OFFSETS FOR 20-FOOT SPEED LAUNCH.

Number of Moulds.	Bow.	1	2	3	4	5	Stern.
Height of gunwale	2′ 0 1-2″	1′ 10 1-2″	1′ 9 1-8″	1′ 8 3-8″	1′ 8″	1′ 8″	1′ 8″
" " keel bottom					0′ 7-8″	0′ 3″	6″
" " No. 1 section		0′ 4 3-4″	0′ 1″	0′ 3-8″	0′ 1 3-8″	0′ 3 1-4″	0′ 6″
" " No. 2 section			0′ 4″	0′ 1 1-2″	0′ 2″	0′ 4	
Half breadths deck		1′ 0″	1′ 5 3-4″	1′ 8″	1′ 7 1-2″	1′ 3 3-4″	0′ 10 3-8″
Half breadths w. l. 4		0′ 9 3-4″	1′ 4 1-2″	1′ 7 3-4″	1′ 7 3-4″	I′ 4 3-4″	
Half breadths w. l. 3.		0′ 8 5-8″	1′ 3 1-2″	1′ 7 1-8″	1′ 8″	1′ 4 1-2″	
Half breadths w. l. 2		0′ 7″	1′ 1 3-4″	1′ 6 1-8″	1′ 7 1-4″	1′ 3 1-2″	
Half breadths w. l. 1		0′ 4 1-2″	0′ 10 3-8″	1′ 3 1-2″	1′ 4″		

Waterlines are spaced 3″ apart. Sections are 6″ apart.

No. 1 and No. 5 moulds are 3′ 0″ from ends of w. l., other moulds are 3′3″ apart.

To be successful, the boat must be very lightly and yet strongly built, all unnecessary weight must be done away with and all parts as strongly connected as possible. The canvas covered type of construction has been chosen, as it gives to the amateur a very easy method of boat building and at the same time the lightest possible boat. The general system of construction is very similar to that described in the recent issues of the canvas covered tender. The construction is, however, much lighter and simpler, as the launch is not likely to be subjected to as hard usage as the tender.

The small power required, 1 to 2 h. p. is a very attractive and economical feature, as it is both cheap in first cost and economical to run, a similar launch having attained a speed of 11 miles per hour with a 1½ h. p. engine. Referring to the lines it will be seen the

be obtained with two persons and with three she will trim lower in the water. The maximum speed will, of course be obtained with the lightest possible load.

To transfer the lines and make ready for building, the usual table of offset is given. As explained in previous articles, the measurements given under "heights" are measured vertically above the base line on the mould corresponding with the number at the top of the column. Those under "half breadths" are measured horizontally out from the center line on the water lines corresponding with the numbers of the moulds given at the top.

The shapes of the several moulds are laid out on thick brown paper, the water lines being spaced 3 in. apart from the base line, a center line is drawn square with the base line, and the two fore and aft section lines parallel with the center line and spaced 6 in.

apart. The object of these section lines is to locate points below where the waterlines are useful, for example, in the body plan. Fig. 4, the two points on mould No. 4 below the lowest water line are located by the section lines.

Referring in detail to mould No. 4 in the top line of the table, the measurements given opposite the half breadths are laid off on the proper waterlines and the deck, the " height of sheer " is then laid up, locating the curve below w. l. No. 1, and lastly, the " height of keel bottom " is set up, locating the center line point. The points should be laid out on both sides of the center line and the curves struck in with a slender batten. To allow for the thickness of the plank, a second curve should be drawn inside at a distance of 3-16 in. The other sections are laid out in the same way. It will be noted that the sheer and level from the stern to mould No. 3, where it rises toward the bow.

The actual outline of the stern is shown by the dotted outline in Fig. 4, and the offsets are:

Deck	0' 1⅝"
W. L. 4	0' 1½"
" 3	0' 11¾"

This outline is laid out the same as the others. The outline of the bow is also laid off; it begins 6 in. forward of a vertical at the forward end of the low water line and has a slight outward curve; the curve below the l. w l. should be similar to that shown. This completes the laying out.

The method of construction is very similar to that of the canvas boats already described in the previous issues. The moulds are constructed to the outlines already laid out, and of comparatively rough stock, but accurately shaped and with the load water line and the sheer line marked upon each. The sternboard is also gotten out of ½-in. stock to the shape laid out, but a small amount must be allowed for the bevel of the sides, about ¼ in. on the sides and ½ in. on the bottom will be sufficient. The two sternboards are joined with a cleat at the center-line, and through fastened with brass screws. The angle between them is obtained as in Fig. 9, by measuring out from the center line 8 in. and forward 4 in. on each side; a templet would best be made for setting these, as the shape given is only correct when they are set at this angle. The two boards are bevelled at the joint; the cleat is also bevelled at the correct angle, and the whole fastened together. In addition to the outline laid out, the upper edge of each board should have a curve or curvature of 1½ in. and the grain should run horizontal.

The stem is ⅝ in. thick, cut to the proper shape; it should be about 1½ in. wide and of pine or other light wood.

For the centerpiece inside, a piece of pine ½ in. thick, 4 in. wide and the length of the boat is needed; the stem is fastened on at one end and the board is tapered down to the thickness of the stem at the extreme forward end.

A foundation is now built, consisting of a board cut to the shape of the keel and set up about 2 ft. above the floor. The proper outline for this foundation is obtained from the laying off table in the line of "height of keel " by measuring them up on the correct mould points, as laid out by the given spacing. The keel, from mould No. 3 forward, is straight.

The centerpiece, with the attached stem, is now laid upon the foundation in the proper position, and bent down into place and held by shores from above. The mould and stern points are also marked on the center piece. The stern should be shored so as to stand exactly plumb when looking at it from forward. The two connected stern boards are now to be attached to the center piece. It is to be noted that from the last mould point to the after end of the stern, outside, is 3 ft. The after end of the center piece is bevelled to the proper angle of the sternboards, and under the cleat joining the latter, which is bevelled off to receive it. The stern boards may now be fastened in place, and should be shored, taking care that the after side of the joint is at right angles to the base line and in line with the stern, fore and aft. The moulds are set up in place at the mould points; those forward of the middle being placed with their after faces on the mould point, and those aft with their forward faces on the mould point. They must be set exactly at right angles to the base line and square with the center line, and the middle points of the cross braces must be in a straight line from the center of the stern to the point of the stern. The setting of the moulds is one of the most important operations concerned in the building of the boat, as any inaccuracy in the setting will result in the two sides being unlike. When correctly set the moulds should be well braced.

A few battens should now be bent around the moulds and the edges bevelled so that the bottom will lie smoothly on the faces of the moulds. The edges of the stern boards and stem are also bevelled at the same time. A permanent bottom should be fastened around on the sheer line, and be allowed to remain until the plank is put on.

The planking is of pine or cedar 3-16 in. thick. Starting at the keel, it is put on in as wide boards as possible and fastened wherever necessary to the moulds with small nails. At the stem and stern it is strongly fastened with small copper or brass nails. The first plank fits alongside of the center plank already in place. The plank cannot be obtained in lengths sufficient to allow each one to be of a single length, but there should not be more than one joint in each plank and the joints in neighboring planks should be well separated. The frames are to be spaced, one at each mould and nine between, making the spacing just under 4 in. The spaces should be laid off, in order that the joints or butts in the plank may be made on the frames.

The planking may be continued, making each plank wider amidships than at the ends. The girth around

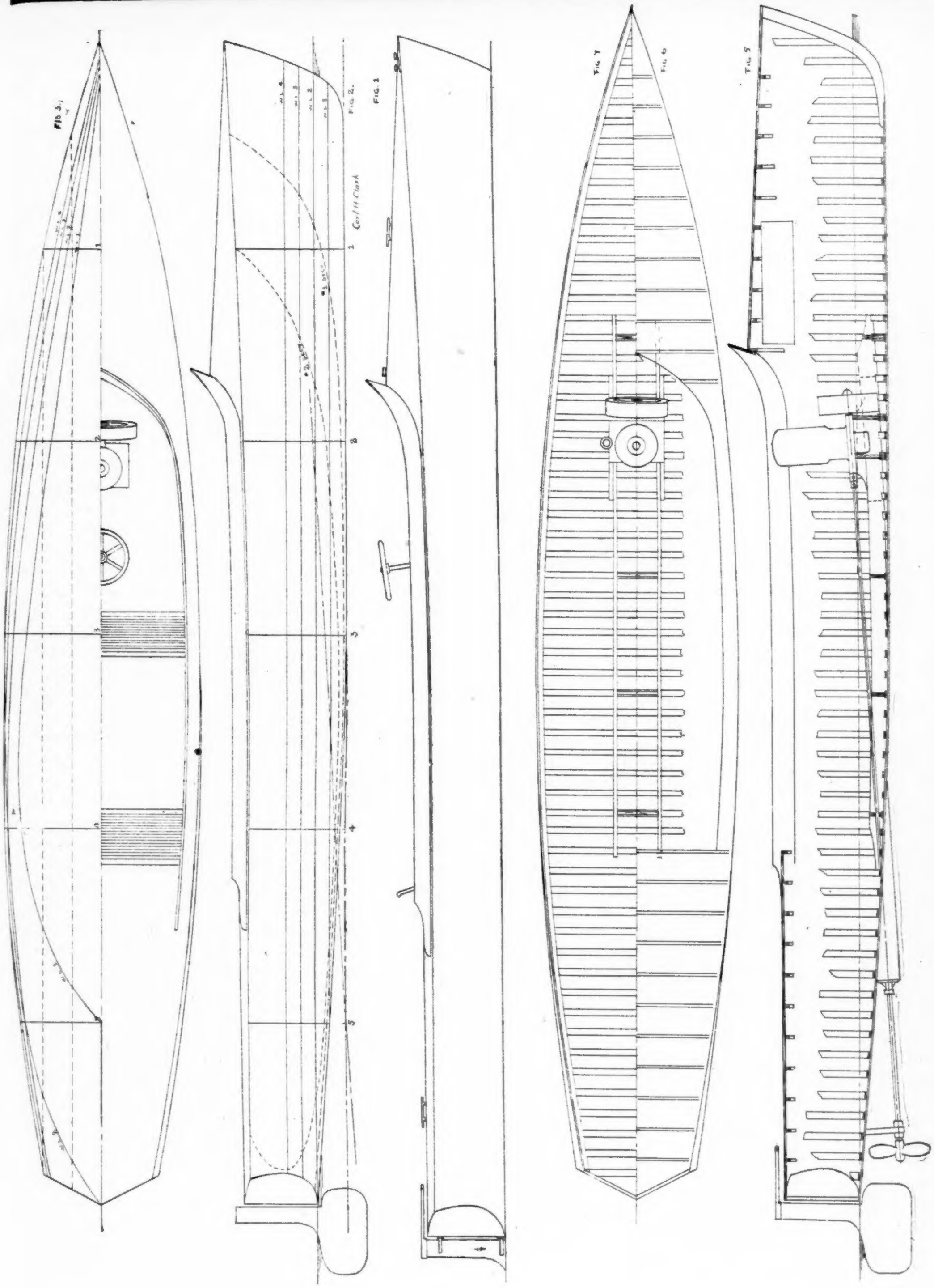
FIG. 3
FIG. 2.
FIG. 1
Fig 7
Fig 6
Fig 5
Carl H Clark

all the mould, should be divided into the same number of nearly equal parts for guidance in planking. By making the plank sufficiently wide amidships they can be run around without a great amount of spiling or curvature and should, if possible, be run the same as in the ordinary construction. If this is not possible or convenient, it may be arranged as in the canvas boat lately described, with the short, wedge-shaped piece on the bilge; the former method is, however, to be preferred. After planking as high as the turn of the bilge, the tops or sheer streak should be put on and the planking continued below. The plank should be cut to fit closely, and no attempt made to force them in place, as there would be a tendency to warp later. The butts of the plank can be fastened temporarily with blocks until the frames are in place.

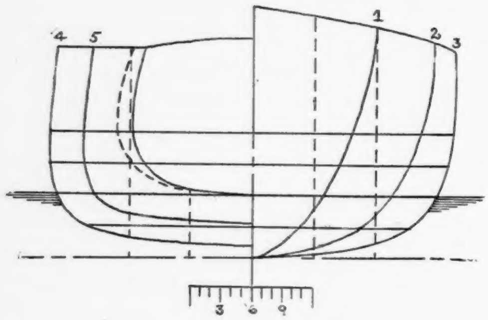

FIG. 4.

The frames are 1½ x ¼ in., of spruce bent in flatwise. They are steamed in the usual manner before bending and should be at least partially fastened while hot. The frames extend from gunwale to gunwale continuous across the center line, and the two outer corners should be neatly rounded, as no sheathing is fitted. Fastenings for the frames consist of copper tacks about ½ in. long with flat heads; they are driven from the outside and clinched inside the frame. They should be used plentifully and carefully clinched to avoid splitting the frame, and should be clinched across the grain, not with it; they should also be driven as near the edge of both plank and frame as is convenient without risk of splitting either. A small brad awl may be handy in boring holes for them. In clinching these points, a heavy hammer is held on the head and a light hammer used for clinching; the point should not be nearly turned over flat, but a small hook should be formed and the point forced down into the wood.

Whenever a butt occurs, a piece of the frame upon which it occurs is omitted to allow the fitting of the butt block. The latter should be about ½ in. wider than the plank it joins and about ½ in. thick, it extends from one frame to the second beyond this cutting the intermediate frame, it should be a neat fit between the frames against which it butts and also against the ends of the frame which is cut. The ends of the plank are nailed to the buttblock with the usual copper nails, care being taken not to split either the ends of the plank or the block. It will be noted that the copper nails are slightly tapered and therefore have a tendency to split when driven home; if this tendency is noted, a small hole should be bored for each. The boat should be allowed to set for a day or two to allow the frames to set in place before removing the moulds. When the latter are removed a frame is bent into the place of each and allowed to harden. The shores may be removed and the boat should be quite stiff and strong.

As the moulds are removed braces must be fitted to avoid any chance of change of shape, and they should be left in place until the deck beams are fitted.

The outside should now be well smoothed up with sandpaper and all nail heads set well in. Although not entirely necessary, it is advised that the seams on the outside be covered with strips of rather thick paper fastened on with shellac and smoothed up; this keeps the canvas smooth and also tends to stiffen the boat somewhat.

The engine bearers should now be fitted, running, as shown, about the length of the cockpit; they are of ⅞ in. pine and should stand about 4 in. above the plank at the engine and taper to 3 in. at the ends. They are placed apart a distance equal to the width of the engine bed, and should be carefully fitted down over the frames so as to rest upon the plank. To obtain the curvature of these keelsons a straight piece of board, is put in the proper position and at certain points the distance from the straight edge down to the skin is measured. The straight edge is then transferred to the stock to be used, and the distances remeasured from it, thus reproducing the curve. The piece is cut out and bevelled to fit along the tops of the frames; the cuts for the frames are then made, and the final fitting done. For fastening these bearers in place copper or brass nails about 1½ in. long are used, driven from the outside. These bearers are really the backbone of the boat and must be well fitted and well fastened. In about the positions shown, short floors or blocks should be fitted between the bearers to hold them upright and also to stiffen the bottom; they are of ⅝ in. pine and are fastened through the bearers, and up from below.

The deck beams are of spruce 1 in. deep and ⅝ in. thick, with the exception of those of the cockpit, which are ½ in. thick. The forward deck beams should have a crown of about 6 in. in 2½ feet, the same curvature being used for all. The after deck beams should have a crown of 2 in. in three feet. Deck beams are all spaced about 6 in. apart. To support the beams at each end a clamp is fastened on the inside of the frames; they are of pine 1½ in. wide and ½ in. deep, and are set down 1 in. below the gunwale so that the deck plank will rest evenly upon the top edge of the top streak when laid upon the beams. The clamps are

laid in horizontal, as shown in Fig. 10, and should be notched over the frames so as to bear both upon frames and plank, and are fastened in place from the outside. These end clamps should extend about a foot beyond the ends of the cockpit. Alongside of the cockpit the clamp is fitted even with the top of the top streak so that the deck will lie upon it; it should also be notched over the frames and should extend beyond the ends of the end clamps already fitted so that the deck will lie evenly upon it after leaving the beams.

The deck beams are now fastened in place at the proper intervals and are held in place by nailing down into the clamps and if desired through the plank into the end of the beam. The beams at the ends of the cockpit are heavier, to take the extra strain at these

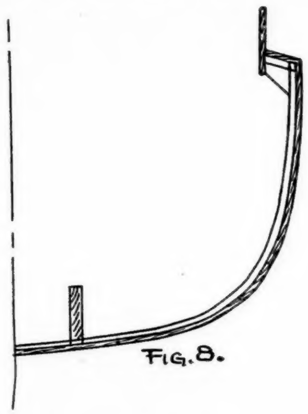

FIG. 8.

points. The cockpit extends from 12 in. forward of No. 2 mould to 8 in. aft of No. 4 mould.

The upper edge of the top streak is now bevelled off to the curves of the beams to allow the deck plank to lie evenly.

The deck planking is $\frac{1}{8}$ in. thick, of pine, and should be in as wide pieces as is possible, not more than three pieces being used for the whole. A wide nearly parallel piece is fitted in the middle of the deck and the two side pieces are fitted tapering. It is fastened to the beams with nails about $\frac{3}{4}$ in. long, and the joint between the boards should be close and even. Midway between each two frames which, as before stated, are 6 in. apart, a binder or thin strip about $1\frac{1}{4}$ x $\frac{1}{4}$ in. is fastened on the under side in the same manner as a frame to support the deck between the beams. The edges of the deck and the top streak are fastened together with slim brass nails, very carefully driven about 2 in. apart. The forward end of the cockpit is curved as shown, and the raw edge of the deck is to be reinforced by a piece of $\frac{3}{8}$ in. stock cut to the proper curve and fastened on the under side. A piece of $\frac{1}{2}$ in. pine is fitted under the deck at the point of the bow to take the bow chocks and another piece under the position shown for each of the two cleats. The deck may or may not be covered with canvas, as desired; the latter course is, however, preferable, as the woodwork does not require to be as carefully done and the deck is more easily kept tight. In case it is not covered it should be 3-16 in. thick, and it may be finished bright in which case a mahogany deck is very ornamental. The entire boat should now be carefully smoothed over with fine sandpaper, and all nail heads well set so that there shall be no unevenness in the canvas.

The hole for the shaft will pierce the hull about 10 in. aft of No. 4 mould. In preparation for this a hole should be made in the canvas at the proper point and a ring of tacks driven around it after filling it with thick paint. This is to prevent the water leaking in between the canvas and the hull. This must be done before the wearing piece is fitted on the outside.

For covering the boat about 10 oz. canvas is to be used; if for any reason 10 oz. cannot be obtained, 8 oz. may be used but the former is to be preferred, as it makes a stronger boat, two 36 in. widths will be required, one for each side, the length of the boat. Specific directions can hardly be given for stretching the canvas. It should, however, be laid on and stretched out lengthwise along the bilge and a little considera-

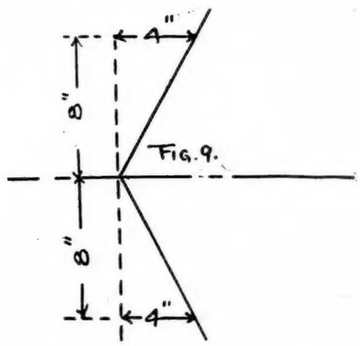

FIG. 9.

tion will decide in which way it can best be laid. It is most likely that it will best stretch out along the bilge, taking wedge-shaped pieces off at each end to fit the center line. The outside of the boat should be covered with thick paint just before laying the canvas. The latter is well stretched fore and aft, and the tacking begun at the center line amidships; a few tacks should be driven at the center line, and then the canvas stretched very tight and a few driven at the gunwale, some more are then driven at the center line, and so on. The first piece to be laid should lap over the center line about $\frac{1}{2}$ in. so that the other piece will overlap it and form a tight joint. The first piece need only be tacked sufficiently at first to hold it, as the tacks driven through the overlapping piece also hold the first. The tacking should thus work gradually towards the ends, always stretching the canvas tightly in both directions. At the bow the canvas is drawn across and tacked to the forward face, and on the stern it is drawn inside and tacked on the flat of

the sternboards inside of the line of the plank. The tacking should be about ½ in. apart.

The deck is covered with lighter canvas, 8 oz. being sufficiently heavy, it is stretched in the same manner and laid in paint; it is drawn over the edge of the gunwale and tacked over the other. The raw edge of the canvas is covered with a ½ in. half round moulding.

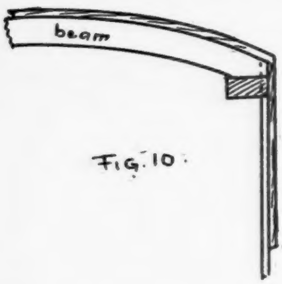

Fig. 10.

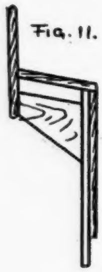
Fig. 11.

A wearing strip of ½ in. pine 3 in. wide is now to be run outside the entire length of the boat; at the bow it is tapered to the width of the boat and is fastened with small brass screws. A stem piece of ½ in. oak is bent around the stem, joining the rubbing strip just fitted.

The coaming is of ½ in. oak and stands 3 in, high above the deck and is curved up at the forward end, as shown. It is fitted and supported by small blocks, as shown in Fig. 11. At the after end it runs out on to the deck and is curved off as in Fig. 5. The forward end of the coaming is sloped forward somewhat to shed the water and also to enable it to be more easily fitted; at the point a small block is fitted on the inside to join the two sides together.

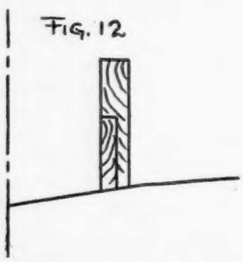
Fig. 12.

The skeg is shaped as in Fig. 5, from 1½ in pine, and bored with a ⅝ in. hole for the shaft, to match that already made in the hull. It is fastened through from the inside and must be carefully lined with the center line of the boat. A very thin lead pipe is now to be fitted inside of the shaft hole extending from the after end of the skeg to the inside of the boat.

The inside of the hole is well covered with paint before inserting the pipe, which is then turned over on end and hammered down close upon the wood, thus making a watertight joint all through.

The rudder is of ½ in. stock of the shape shown and is 16 in. long; the part forward of the forward edge of the stock being 2½ in; the straight stock is 3 in. wide. A cleat is fastened along the lower edge to prevent its warping. The rudder is swung upon either the usual rudder braces or upon brass screw eyes. In the latter case four eyes are used and a brass rod is passed through, the lower eye taking the weight of the rudder. By so fitting the eyes that those on the rudder just fit between those on the hull, the rudder is held exactly in place. For a tiller a light brass casting may be made, or a wooden tiller may be used, with a strap of sheet brass passing around the rudder stock and fastened to the sides of the tiller.

The outside of the boat should be painted several light coats of lead paint, to fill up the pores and lightly rubbed with sandpaper after each coat is dry. The inside and the stern boards may be finished bright, being first given a coat of shellac.

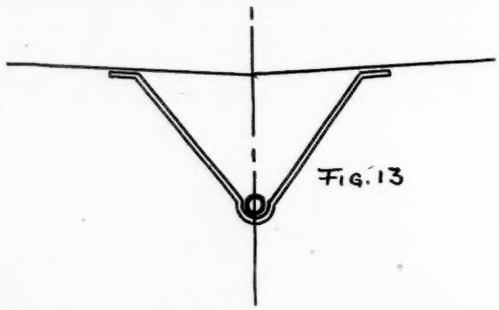
Fig. 13

The seats are best made of narrow slats, as shown; the positions may be noted in relation to the mould points. They should be supported upon strips fastened along the side of the boat, and should have braces near the middle. Across the deck aft of the cockpit a finishing strip is run, covering the corner.

If desired, a light floor may be laid over the engine bearers, but it is advised to leave it open and finish the bearers the same as the inside in order to save weight.

The engine foundation is constructed, as in Fig. 12, of 1½ in. pine plank cut out to fit alongside the keelsons already fitted, and is fastened to them. This gives the necessary width for strength and for fastening with the lag screws. The cross braces between the bearers before mentioned should extend as high as possible and cut out to fit around the engine base. In fitting the bed a line should be run through the stern tube and extended forward over the engine bed, and by reference to the engine the necessary position of the bed may be determined. The position of the extreme after end of the shaft should be also noted for use in fitting the propeller.

Lining up the engine should be a rather particular piece of work, as the shaft must enter the engine coupling perfectly straight as otherwise it will bend at

CONCLUDED ON PAGE 247.

LAPS AND LAPPING.

ROBERT GIBSON GRISWOLD.

The finishing of machined surfaces by the process of lapping is in reality a fine art. No other method presents such possibilities in the way of finished surfaces and accurate fits as does this very excellent method of grinding.

This process is used very largely for truing up holes in cylinders in which a very fine running fit is desired, such as the spindle of a boring mill or vertical drill. Guides of delicate precision machinery are frequently finished by this method, and in the construction of fine measuring instruments it is invariably used.

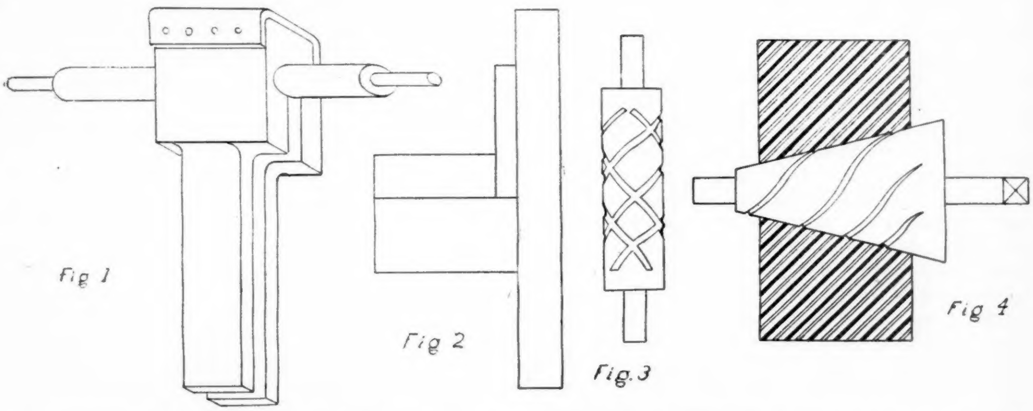

Fig 1 Fig 2 Fig. 3 Fig 4

To illustrate with what degree of accuracy work finished by this method may attain, the writer begs permission to cite the personal experience of an expert tool maker. The question of accurate methods in the construction of sizing blocks was under discussion when the tool-maker took from his tool-chest a neat, flat case which, upon being opened, displayed neatly arranged each in its own velvet-lined pocket, twenty-four sizing blocks ranging from 1-32 in. to 1 in. in thickness. The workmanship was faultless and each bore a polished surface so bright that even the smallest exterior detail was perfectly reflected as if from the surface of mercury. These blocks were made of hardened tool steel, finished by hand exactly to size.

Accompanying this set was a signed certificate from one of the foremost tool-making concerns in the country, stating that this set of blocks had been tested by micrometers and found to vary less than the ten-thousandth part of an inch from size, and also that the angles were perfect right angles. So perfect were these blocks that if any two of them were wiped perfectly dry and placed together by sliding over one another, they would adhere very tenaciously, proving that this fit was so perfect that even a layer of air could not possibly be imprisoned between them. Not only would two of them hang together but almost the entire lot could be supported one from the other in a string when properly placed in contact. This beautiful finish and accuracy in size was obtained by hand lapping on a true cast iron surface plate, without lubricant or abrasive. Unless one has seen such work they can scarcely realize what patience and skill are required to accomplish this result.

The simplest piece of lapping which, by the way, is really nothing more than fine polishing, is the finishing of a cylindrical, turned piece in a lathe. This is shown in Fig. 1. Two pieces of hard wood are shaped so that they may be easily manipulated and a semicircular recess cut in each to fit the work. The two pieces are then fastened together with a strip of leather to act as a hinge.

The clamps are now charged with a thin coating of rather fine emery and flour and oil and closed over the revolving piece in the lathe. This coating of emery soon cuts away the imperfections on the surface of the work when another charge of a finer grade of emery and oil should be applied. Plenty of oil must be used in order that the inside surfaces of the blocks do not become dry. When the grinding has brought the surface to a very smooth finish, clean out the blocks and charge with a thin coat of washed Turkish emery and oil, or crocus and oil. This will give the work a beautiful, smooth polish and the work will be found remarkably true and round.

These clamps are held in one hand and only sufficient pressure exerted to cause the charge to cut. The blocks are constantly moved to and fro along the piece

so that the minute scratches cross each other, thus removing the appearance of a series of circular scores in the surface. With a little practice this method will produce beautiful surfaces, especially in hardened work. Soft materials are not so easily polished by this method as the pieces or grains of emery are easily embedded in the wood, and they often cut very deeply.

The lapping of a hole is not so readily accomplished. In the first place the laps are made of either soft cast iron, copper or lead, the latter being most frequently used. This lap is shown in Fig. 2. A mandrel is first turned up with roughened surface, to which the lead will stick, and around this mandrel is cast a layer or cylinder of lead slightly larger than the finished hole. It is then placed in a lathe and turned to such a size that it will just push into the hole. Several small grooves are then cut spirally around the circumference, with a small, round-nose chisel.

The lap is then charged with flour of emery and oil until the grooves are filled and the lap is pushed into the hole. It is then twisted backwards and forwards either by a machine or a wrench applied to a square end on the mandrel. As the grains of emery roll out of the slots between the inside surface and the lead, they imbed themselves into the lead, leaving numberless small teeth exposed which cut the surface of the steel as it passes over them. When worn down so that little cutting is accomplished a fresh charge is applied and the grinding continued. A final charge of crocus or washed emery finishes the hole to a beautiful polish and almost true to size.

Of course the most accurate way to finish a hole is by grinding, but there are many times when a grinder cannot be used and the above method forms a cheap and effective substitute. The same precautions are necessary in this case—keep the lap constantly moving to and fro in an axial direction so that the grains cannot follow their previous cuts, and always turn in one direction.

The lap for finishing a tapered hole is shown in Fig. 3. This lap is made in exactly the same manner as above described, but the grooves should all be cut in one direction. Then the lap should be turned in such a direction that the tendency of these grooves is to throw the lap out of the hole. If turned in the opposite direction the tendency is to screw itself into the taper so that it is impossible to twist it, especially where the taper is slight. It is more difficult to tap a hole of this character than a straight one, owing to the lack of the axial motion to prevent cutting.

The lapping of a square piece is undoubtedly the hardest job. A rather different scheme is used in this case. The block is first filed or ground nearly to size (within one or two thousandths) and one side is rubbed on a smooth cast iron plate with only a very small quantity of crocus and a light oil. This rubbing is a difficult operation to prevent the piece rocking slightly while being moved, which would undoubtedly cause the edges to wear faster than the central portions. While not entirely overcoming this tendency, placing the tip of the middle finger on the center of the piece and thus imparting motion thereto will afford a fairly even pressure over the entire surface.

When this surface has been ground perfectly true, the next one is finished until it is square with the first. Only patience and labor will bring successful results. When the four sides are ground true with one another, the ends, if the piece is oblong, may be lapped by holding against the blade of a small square to prevent rocking, as shown in Fig. 4. The finishing operation is done by rubbing the surface on a clean cast iron plate, free from oil or any abrasive. This puts on a beautiful polish.

The process of lapping, while only resorted to in cases where grinding cannot be done, is one that should be understood by all mechanics, as there are many cases where it is absolutely necessary to use this method. The finish produced on flat surfaces by lapping is beyond criticism and cannot be equalled by any other method, a buff finish being the nearest approach thereto.

AN ANCIENT TUNNEL.

Evidence exists that, 24000 years ago certain Hebrew engineers executed the same kind of work as that of the Simplon tunnel, though perhaps on a smaller scale, says the "Engineer." Owing to the bad state of the water supply of Jerusalem, the king ordered a reservoir to be made at the gates of the city, to which water was brought from various springs.

Recent explorations have enabled this predecessor of the Simplon tunnel to be identified, and it is said to be the Shiloh tunnel, by means of which water was brought down from a source to the east of Jerusalem and poured into the pool of Siloam. This conduit is 360 yards long, and the distance, as a bird flies, between the two mouths of the tunnel is also only 360 yards.

Work was commenced at both ends of the tunnel and the direction was altered several times. The floor of the tunnel is finished with great care, and the workings are from 1.9 feet to 1 yard in width and from 3 to 9 feet high. In the light of modern engineering ing science it may be asked how these old-time engineers gauged their direction and recognized and remidied their errors in alignment. What tools did they use in executing this work which has remained without equal for 2400 years?

Priming in a boiler is simply the mechanical rising of water by steam in its effort to get out, and if the steam space is drawn upon and emptied, the boiler is almost sure to prime. The steam space should not be less than one-third the volume of the boiler.

COLORING WOOD FOR INLAYING.

Fancy colored woods for inlaying very much enhance the effect of work of this character. The usual material employed for staining white deal and other plain woods to imitate woods of a different texture or superior quality are various decoctions of vegetable matters, such as logwood, Brazil and sandal wood, and tumeric, etc., are used for producing reds, browns and yellow; while various mineral bodies, such as picric acid, permagnate of potash, caustic lime, etc., are used for deepening the color of woods and otherwise altering their character; but none of these materials produce bright, vivid colors, such as blue, golden yellow, green, etc.

Of course, for furniture and woods used in decoration, such vivid colors are out of place, but for inlay work, bright, fancy colors are applicable, and by means of aniline dyes can be produced in an infinite variety of hues. But to produce successful results precautions are necessary, because these dyes act so energetically on all organic structures, such as woods, leather, ivory, etc., as to enable many different shades to be obtained by any particular dye. For example, a very strong solution will produce a coloration so deep and intense as to exhibit a bronzed appearance, but any number of successive applications of weaker solutions will not produce such a deep coloration; on the other hand, if only a very weak solution of the dye be used at first, it is possible to produce any gradation of tones by the subsequent application of successively stronger solutions of the dye, but it must be borne in mind that the strength of the dye first applied, and the temperature at which it is applied, determines the resultant color; consequently, to produce any desired tone, experiments should be first made on small pieces of wood before proceeding to stain the whole of it.

AQUEOUS DYE SOLUTIONS.

There are two kinds of aniline dyes—one set soluble in water, and the other soluble in spirits. Both kinds may be used for producing dye solutions, but for penetration, especially on hard woods, the alcoholic solutions are preferable, but good results can be obtained with either class of dye.

To prepare an aqueous dye solution, put one ounce of the dye into a clean earthernware pan or jar; never use a metal receptacle, nor a wooden one, because metal will react on the dye and its color, and wood will absorb some of the dye and not only thereby lessen the strength of the solution, but the wood will become so impregnated with the dye it first comes in contact with, that such vessel cannot be used for preparing a dye bath of any other color. Pour one quart of boiling hot water on to the dye and stir it up with a glass rod or wooden stick and let it settle for an hour or two; then filter the dye liquor through a plug of cotton wool inserted in the neck of a glass funnel, and store the dye liquor in clean bottles for use, not forgetting to label it with the name of the dye and its strength, such as "the strongest solution."

Now one ounce of aniline dye will generally be more than one quart of water will completely dissolve, consequently the dye that has been collected in the filter will still yield a second decoction, so remove the plug of cotton wool from the funnel and put it in a glazed jar or pan and wash all the dye that adheres to the funnel into the vessel by pouring one quart more of boiling hot water on it, and when the liquor has extracted all the coloring matter it can, filter it through a fresh, clean piece of cotton wool.

Label the second batch of dye liquor and mark its strength as being second strength, or No. 2 solution. To use these dye liquors it will be found that the first quantity of liquor obtained will be too strong to use unless it is diluted, being of concentrated strength; the dye, as it dries, will exhibit a bronzed efforesence or irridesence; therefore a little of the liquor should be taken and diluted more or less with hot water, according to the tone of color it is desired to exhibit.

In using the dye liquor of the second strength, that will not be strong enough to produce a bronzed surface, and therefore may be used undiluted, if so desired. It is best to prepare these dye liquors in two strengths of solutions, as by that means one solution can be strengthened at any time by the addition of some of the concentrated solution.

PREPARING "TINCTURES."

To prepare alcoholic solutions or "tinctures" of the dye proceed as follows:

Put ½-oz. of the dye into a clean glass bottle and pour on it one quart of rectified spirits, or else methylated spirit (but the spirit must not be methylated with any mineral oil, such as paraffine or benzol, as these hydrocarbon fluids do not dissolve the dye); shake up the fluid several times during the first few hours, and then let it rest for 24 hours; then decant the clear fluid from the dregs. If it be filtered, a piece of clean blotting paper or filter paper should be used, and a plate or saucer placed on top of the glass funnel so as to prevent the spirit evaporating while filtering. The dregs or residue may be treated with a fresh portion of alcohol to produce a weaker tincture. Each of these batches of dye should be stored in closely corked bottles and labelled first and second strengths, together with the name and color of the dye.

Besides "water" and "spirit" dyes there is a new class of analine dyes, which are soluble in oils and fats. These dyes are known as "oil" dyes, and are very useful for coloring varnishes and wax compounds, but they are not so useful for staining purposes.

METHOD OF APPLYING THE DYE.

A brush and sponge can be used for applying the the dye liquor, but to prevent the coloration being uneven, patchy or streaky, the fluid should be quickly and evenly applied all over the surface to be dyed; the operation should be rapidly performed, and sufficient dye liquor be contained in the brush or sponge to flow over the whole of the surface at once. This is necessary, because wherever the dye just touches the wood it sinks into the fiber at once, and the tone of color obtained depends on the strength of the fluid; that is, a spongeful of the fluid produces a deeper coloration than that which is obtained when half the liquor has been absorbed out of the sponge; therefore, be rapid in the application, and keep up a plentiful supply of the dye to the surface, until it is all flooded evenly with the dye.

Then let the wood remain in a warm room to dry; owing to the thinness of fretwork it is liable to warp and curve up if too much liquid be applied at once. Therefore it is best to have the dye liquor of sufficient strength to strike the tone at once by a single application, but when graduations of tone are desired, the strength of the dye liquor can be weak at first, and successive applications of stronger liquor made, but each one should be nearly but not quite dry before applying the next.

Any attempt to keep the wood flat by laying weights on it while the surface is wet with the dye will only spoil the coloration. If the wood does curve up, it is best made flat again by first allowing the dyed surface to dry and then wetting the wood on one or both sides and laying if between two boards that are weighted down; the dye having soaked into the fiber and become combined therewith will not be so liable to be rubbed off when wetted subsequently.

Another way to straighten the wood is to hold it over the spout of a kettle from which steam is escaping, and then lay it flat between boards. If the wood is to be colored on both sides, and be stained throughout its thickness, it is best to steep the wood in the dye liquor for three to five minutes, at a suitable temperature, remembering that the hotter the temperature of the dye liquor the deeper the stain produced.

After coloring the wood, its surface should be smoothed by lightly sandpapering. If the fiber is not raised by the hot liquid, or if only slightly raised, it may be smoothed by rubbing it with a piece of stiff felt. To fix the dye in the fiber so that it shall not be rubbed off if the wood becomes wetted or damped, a wax polish can be used, or a solution of casein may be laid on the surface with a sponge or brush and allowed to dry. The casein solution is made by dissolving dry casein in a saturated solution of borax until the mixture results in a fluid of the consistency of gum mucilage.

Dye solution can be used in exactly the same way as above described for dyeing and coloring leathers, provided the leather has not been previously colored. In some few cases it will be found necessary to employ a "leveller"; that is, a fluid applied to the wood before the application of the dye liquid, so that the dye will spread on the fibre uniformly, and produce an even coloration. Such levellers are usually sulphate of soda, acetic acid, sulphuric acid diluted, common salt, acetate of soda, etc.

FORMULÆ FOR COLORED DYE LIQUORS.

The following formulæ will serve as a guide in preparing suitable colored dye liquors. In all cases the water is reckoned in 100 parts.

Reds, 1.—Eosine 1 part sulphate of soda, 10 parts; acetic acid 3 parts.

2.—Magenta No. 2 B, 1½ parts; auramine, 1 part; 10 parts sulphate of soda.

3.—Azo cochineal, 2 parts; sulphate of soda, 10 parts; sulphuric acid, 2 parts.

4.—Water, 10 parts; rose benzol, 5 parts; first wet the wood with alum solution.

Yellow. 5—Auramine, 4 parts; sulphate of soda, 10 parts.

6.—Naphthol yellow, 1 part; soda sulphate, 10 parts; sulphuric acid, 2 parts.

7.—Crocein orange, 1 part; soda sulphate, 10 parts; sulphuric acid, 1 part.

Brown. 8.—Bismarck brown R, 1 part; nigrosine, ½ part, soda sulphate 18 parts.

9.—Same as No. 8, omitting the nigrosine.

10.—Benzo brown, 3 parts; common salt, 10 parts.

Green. 12.—Brilliant green, 3 parts; Bismarck brown ½ part; soda sulphate, 10 parts.

13.—Brilliant green, 1 part; chrysoidine, 1½ part; soda sulphate, 10 parts.

14.—Green crystals, Y, 1 part; soda sulphate, 10 parts.

15.—Malachite green, 1 part; Nile blue, A, ½ part; soda sulphate, 10 parts.

17.—Victoria blue 42, 1 part; soda sulphate, 10 parts.

16.—Nile blue, 1 part; soda sulphate, 10 parts.

18.—Water, 8 parts; soluble blue, R, 3 parts.

By first giving the wood an application of some kind of dye, say a yellow, and before it is quite dry, an application of another kind of dye, say a blue, different colors, such as green orange, purple black, or brown stains can be produced. By such process of mixing the dye liquor, all sorts of color combinations can be secured and very beautiful results obtained.—"Hobbies, London."

When the first two tons of anthracite coal were brought into Philadelphia, in 1803, the people of that city, so the records state, "tried to burn the stuff; but at length, disgusted, they broke it up and made a walk of it." Fourteen years later, Col. George Shoemaker sold eight or ten wagon loads of it in the same city, but warrants were soon issued for his arrest for taking money under false pretenses.

PHOTOGRAPHY.

FOG: ITS CAUSES IN PLATES AND ITS PREVENTION.

COLVILLE STEWART.

A plate is said to be fogged or foggy when the portions of the film which have not been exposed to light in the camera become dark or black in the developer. Every plate on very prolonged development shows some signs of fog, and quick plates are liable to become fogged more readily than slow ones, though with normal development both should work quite cleanly.

Fog is caused, then by the developer acting upon the film even when unexposed, and the action of the developer in producing fog is always accelerated by forcing, by warmth, or by unsuitableness of character. All plates would fog if left long enough in any developer, so that normal time is always to be desired.

Sometimes too much exposure to an unsafe dark-room lamp will fog the plates, or a stray streak of white light which has no business in the dark-room; but this is "light-fog," and can only be caused by carelessness. The other kind of fog may be termed chemical fog, and this the kind which can almost always be obviated.

Now when a plate is very fast, besides being very sensitive to light, it is also sensitive to the developer. Any developer will fog if allowed time, as I said, but some developers are much worse than others, and some are much more suitable for certain brands of plates than others.

Metol and amidol are the developers most likely to produce fog, because they are the most energetic. Pyrogallic acid and hydroquinone are "clean-working developers, because they are less energetic and take longer.

Potassium bromide, sodium sulphite, and potassium metalbisulphite are three chemicals with which we can enable the developer to work cleanly. But for every improvement we make in a developer, there is sure to be some counteracting disadvantage, and so it is that the more bromide we have the slower will development take place and the less we shall get out of our exposure. If your plate is rather under-exposed, you naturally do not want to lose any of the effect of exposure, and this is why I think you will prefer, after an experiment or two, to dilute your developer with water and give the plate plenty of time, rather than use a vigorous developer with bromide in it to prevent fogging.

A fairly dilute pyro soda developer "wants a lot of beating," especially for the beginner, but at the same time any developer which the makers of a plate recommend is sure to be all right for that plate. Not necessarily for other makes, though! There is a certain class of photographers who try every make of plate on the market with the same developer, without thinking that it may be unsuitable for some brands, and they express an opinion on different makes which is neither correct nor reliable. So when you try a new brand of plate, use the developer recommended for it and give it every possible opportunity of showing its good qualities.

Prolonged development is, of course, sometimes necessary, and an impurity sometimes gets into the developer; both these circumstances may cause fogging of the clear portions of the negative. In such cases as these, try soaking the plate for a minute in four ounces of fixing solution, to which has been added a few drops of a one in five solution of potassium ferricyanide. Do not leave the plate in this too long, or it may reduce the negative itself.—"Amateur Photographer."

BACKING MADE EASY.

FREDERICK ALLEN.

There must be very few people at this time of day who believe that the results obtained on unbacked plates are equal in quality to those when the plate has been properly backed with an efficient backing. I have heard a photographer say that he hated backed plates because they were so "messy," although he did not explain in what way the messiness manifested itself. If he meant that the backing was messy to apply, I can only say that it is clear he did not set about its application in the proper way. If he meant that it washed off in the developer, and made that a little thick, I feel inclined to ask him—what did it matter?

The soundest objection to backing is the extra cost of backed plates. Those who do not mind the comparatively small increase in price will be well advised if they buy their plates backed, because not only does this save the trouble of applying the backing, but it also insures the backing being thoroughly dry, and

prevents any risk of fogging the plate with actinic light, either while it is being backed or when it is being dried after backing. Besides, the backing applied by the maker is more likely to be efficient than when the plate is backed by the user; though if the method which I employ myself, and recommend, it adopted this should not be the case.

To make a backing frame is very simple. We first want a piece of flat board, a trifle larger than the plates in use; mine is a piece of deal 7 x 5 in., which is plenty big enough for half-plates. Even this is not a necessity, at a pinch a sheet of stout strawboard will answer every purpose. Two pieces of much thinner card are required, the same size as the thicker card or board, and having found the center of each, one of them should have a hole cut in it a shade larger than half-plate: say 6 17-32 in. by 4 24-32 in. and the other a hole 6 3-8 in. x 4 5 8 in. Both these holes, which leave a little more than a narrow frame of card, should be cut carefully central, so that when glued flat upon the board, the one with the larger hole on top of the other, they form a kind of rebate in which the plate rests without danger of moving, while except at the edges, its underneath side is not in contact with anything. When this has been done, and the glue is quite dry, a thumb-hole is cut at one side through both cards, extending a little way into the wooden base, so that when a plate is put into the frame it can easily be lifted out. The backing frame is then complete, though it will be all the better for a coat or two of good varnish. My own has had two coats of white enamel.

The use of such a frame is quite simple. The plate is laid in it sensitive side downwards, and the back is rubbed over with backing. I keep my backing in an old pyro bottle, and have a circular dabber made by tying up a ball of cotton wool in an old handkerchief folded in four. The dabber is kept in a pot with a lid such as shaving cream, etc., is sold in. This keeps it clean and ready for use. A few drops of backing are poured into the pot, the dabber well worked up with it, and then the back of the plate is rubbed over. The merest film is effective, and there is no need to give an even coating so long as there is enough everywhere. A piece of paper the size of the plate may be laid down on the backed surface, and the plate can then be put straight into the dark slide. It is a neater plan to stand it up in the dark to dry, but this is not always possible, and there is no serious objection to the other course.

The cost of backing in this manner is so trifling that it is quite unimportant to anyone able to afford to use a camera at all.

Lantern plates used for transparencies and for enlarged negatives are all much improved by backing—in fact, those who like to see clean, bright negatives, with edges free from fog, and with no suspicion of halation, will be wise if they make it a rule to back every plate they use.—Photography.

MOONLIGHT EFFECTS.

Although there is a particular shade of carbon tissue on the market that for moonlight effects leaves little to be desired, it is not every worker who is prepared to turn out carbon prints, says Fayette J. Clute in "Western Camera Notes." The ferro prussiate or blue print process does not exactly fill the requirements. I saw some bromide prints the other day that, without actual side-by-side comparison, I should say were even more pleasing than the same prints made in carbon. The method by which they were produced is as follows: The bromide prints, which should be rather light, are toned to almost a bright red in a bath composed of

Uranium nitrate	40 gr.
Potassium ferricyanide	40 gr.
Acetic acid	2 dr.
Water	16 oz.

and then immersed in a weak solution of iron perchloride. The change to a bluish green at once takes place.

WHEN THE GOVERNOR HUNTS.

With two-cylinder engines it sometimes happens that when they are throttled down to go slow, that the throttle valve, while open wide enough otherwise, keeps shutting off the flow of gas entirely. To obviate any difficulty of this kind, says the "Automobile Magazine," it will be found that a small by-pass drilled in the throttle valve allows the engine to run more slowly. This hole also prevents the objectionable "hunting" of the governor, with the result that the engine runs more regularly. A hole of about one-eighth of an inch in diameter should be quite large enough, but the exact size can only be determined by trial. It is, therefore, advisable to drill a smaller hole and file it out to the required size. To stop the engine when a by-pass is fitted, the ignition circuit must be broken by means of a switch, which should fit so that it can be conveniently operated by hand.

Electric power is now being applied to the currying of horses in Chicago and New York. Two small dynamos are secured to the stable ceiling, and from them long flexible tubes depend, attached to each of these being a small brush buzzing around in a dizzying whirl. All the men have to do is to keep moving brushes about from one part of the animal's anatomy to another. Expert hostlers say it takes about 20 min. to clean a horse with the ordinary currycomb, while only four with the the electric brush. The revolving brush is also said to be be beneficial in causing the blood to circulate properly.

MAKING BLUE PRINTS.

JACOB GLOGAN.

One of the important adjuncts to mechanical drawing is that of "blue printing." To obtain a blue print you must have what is known as a tracing of the drawing. To get the tracing transparent tracing paper or tracing cloth is used. This tracing paper is placed over the original drawing and the tracing is made. There are two surfaces on tracing cloth, namely: the smooth or glazed side and the dull side. The dull side is the side which you place against the original drawing.

After the tracing is ready the blue print is made. Blue print paper can be obtained in any mechanical drawing supply store, but if you wish to make it yourself, it is made as follows: Dissolve 1 ounce of ammonia citrate of iron in 6 ounces of water, and in a separate bottle dissolve the same quantity of potassium ferri-cyanide in 6 ounces of water. Keep these solutions separate and in a dark place, or the solutions will be of no use. To prepare, mix the same amount of each solution and with a sponge or soft cloth spread it evenly over the surface. Let the paper remain in a horizontal position until the chemical has set on the surface, then hang the paper up to dry. When drying, see that no light strikes the paper or it will lose some of its value.

To make a blue print from the tracing, place the tracing with ink side out against the glass surface of the printing frame, then take the blue print paper and place the sensitized side down on the tracing. On the top of the paper place a felt cushion, which generally accompanies a good printing frame, and then put in place the hinged back of the printing frame. After this is. done expose to the sunlight. To make good blue prints, being guided only by the exposed edge of the sensitized paper, take a small test piece of the same paper and a piece of tracing cloth with a few lines drawn on it and expose that to the sunlight the same time that you expose the large print.

By having a dish of water at your side you may tear off at different times pieces of the test blue print and wash it in the water. If the test piece shows up in a deep blue color and clear white lines, then it is time to take the big print out. After the print is taken out, it should be washed in cold water for ten minutes and then should be hung up to dry. Corrections can be made on the print with an ordinary writing or ruling pen and a solution of washing soda, caustic potash, strong ammonia, or any other alkali.

To obtain sharp lines on a blue print, all lines on the tracing should be heavier than on ordinary drawing paper, and a sharp inking pen should be used.

By using the following solutions, prints having blue lines on a white ground or just the opposite of a blue print may be obtained: 3 oz. common salts, 8 oz. ferric chloride, 3¼ oz. tartaric acid, 26 oz. accacia, 100 oz. water. Dissolve the accacia in half the water and dissolve the other acids in the rest of the water, then mix the two together. The solution is applied with a brush to a well-rolled paper in a subdued light. The paper should be dried as quickly as possible on account of the acid eating into the pores. When the paper is dry it is ready for use. One or two minutes are sufficient in strong sunlight, and a considerable longer time in a dull light.

To develop the print, it must be washed, after leaving the frame, in a very weak solution of potassium ferricyanide. None of this solution should touch the back of the print. Developing takes but a minute or two. If the background of the print is of a blue color, the print was not exposed long enough, and if the background shows a pale blue color, then the print has been exposed too long.

When development is complete, the print is washed in clean water for two or three minutes, and then placed in the following solution for ten minutes: 3 oz. sulphuric acid, 3 oz. hydrochloric acid, and 100 oz. of water. In this solution all the iron salts not turned into blue compound, will disappear. After this is done the print is washed in water and then allowed to dry.

One of the important uses of blue prints is its use in the shop of the mechanic or engineer. The best advice to be given to them is to take the blue print and mount it on a pasteboard back, but if it is required to keep the prints in first class shape, mount them on sheet-iron or zinc backs and then apply a coat of varnish over each side to make it waterproof.

To make drawings from the prints, the blue prints may be inked over with waterproof ink and when thoroughly dry, washed with a solution of oxalate of potash; treated thus, the ink lines will remain and the blue ground will fade, leaving the background white and appear like an original drawing.

Erasing on tracing cloth, in case of mistakes or errors, should be done with an ink eraser or a sharp, round erasing knife. The surface of the tracing cloth must be made smooth in those places where erasing has been done. This is done by rubbing the cloth with soapstone or powdered pumice stone or talcum applied with the fingers—"The Practical Engineer."

The man who wants to "take it easy as he goes al ong" can do so in the full assurance of never being overburdened with a weight of this world's goods or responsibilities.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

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TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter Jan. 14, 1902.

JULY, 1906.

A large number of replies have been received in answer to the editorial competition mentioned in the June number. Many valuable suggestions have been given, and arrangements are already being made to utilize some of them at once. Others, requiring longer preparation, will be taken up at an early date. We are grateful for the very evident interest shown by such a large number of readers, and our sincere thanks are given to those who have generously responded to our requests. The winners of the awards will be given in the August number.

One prominent feature peculiar to all the letters received in this editorial competition, is the statement that the magazine is "practically helpful"; that the various topics presented in succeeding issues are completely and plainly treated, making the information given usable to the fullest extent. This idea is the one we have tried to continually follow in the conduct of the magazine, and this evidence that our efforts have been successful is especially gratifying.

In this issue we publish a description of a speed launch which will be of interest to all who obtain their boating recreation upon protected waters. The type of construction makes it particularly suitable for rivers and lakes, and the cost of building one is so small as to place it within the reach of anyone able to buy a light 1½ or 2 h. p. engine. It can be built by anyone having ordinary skill with wood working tools, and provides an excellent substitute for a motor canoe, being a much more seaworthy craft.

For these reasons we would request our regular readers to call the attention of friends to this boat, recommending them to buy a copy of this issue of the magazine, either of a news dealer or by sending direct, to this office. We anticipate that the edition will be quickly exhausted, even though we are printing an extra large edition; so to insure getting a copy an early order will be necessary.

The constitution and by-laws of the American Society of Model Engineers is about ready for mailing to those who have made requests for the same. Some important changes from the original draft were deemed advisable, in the interests of simplified government. As during the summer, no general work would be probable, the beginning of active operations is postponed until the coming fall, when we fully expect to see formed a large and interested society membership in which will be of great practical value.

The "free" alcohol bill which goes into effect Jan. 1, 1907, will have an important influence upon the fuel market for motor cars and boats. Many important features bearing upon the manufacture and sale of alcohol have yet to be determined before it will be possible to tell how great a benefit will follow the advent of cheap alcohol. Motor manufacturers will have much experimenting to do to produce a motor capable of using both gasoline and alcohol to good advantage. Alcohol requires a much greater heat to produce a workable vapor, and motors using this fuel are run with very high compression.

From this brief statement it will be seen that denatured free alcohol does not mean an immediate relief from high cost fuel. The greatest benefit will probably come from a lessened use of gasoline in those sections the country where grain and fruit alcohol can be produced as a by-product, and consequently sold with profit at a very low price. The lessened sale for gasoline thus caused will tend to lower the price throughout the country.

One important benefit from free alcohol will be that farmers can, by distilling their own fuel, use motors for power purposes, and the farmer boy will no longer dread the wood pile and feed cutter, but become an amateurn egineer and have lots of fun running a small lighting and power plant.

CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

II. Two Cycle Engines.

The ordinary type of two cycle engine is illustrated in Fig. 8. *A* is the cylinder of cast iron, in which travels the piston *P*. The piston is shown in its lowest position, its highest position being at *a*. It will be noted that from a point just below *a* the bore of the cylinder is slightly increased; this is termed the counterbore and is for the purpose of allowing the piston to over run the edge of the working part of the cylinder bore and prevent it from forming a shoulder at the upper end of its stroke as the bore wears. There is a considerable space above *a*, which is called the compression space, for compressing the gas, as before explained.

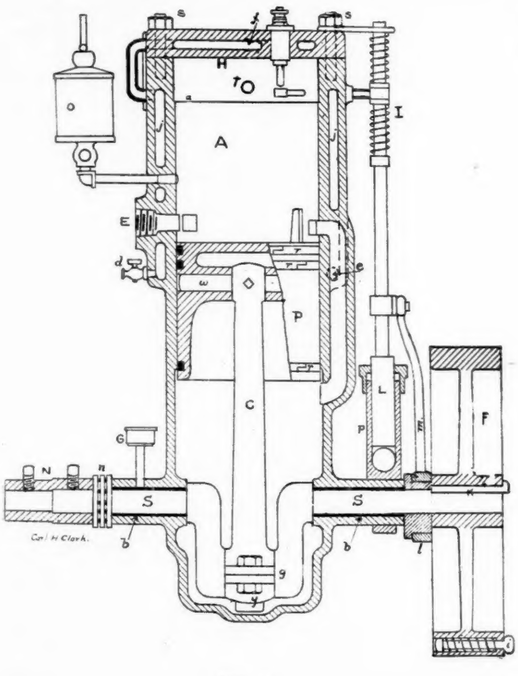


FIG. 8.

The cylinder is surrounded by the water jacket *j* through which water is circulated to carry off the excess of heat which is generated in the cylinder and which would otherwise cause the cylinder to become overheated and perhaps injured. The jacket surrounds the cylinder and sometimes the exhaust pipe, and extends well below the lower end of the bore.

H is the cylinder head, which is also hollow for water circulation, except in the small sizes. The head is held in place by the bolts or studs *ss*; the joint between the cylinder and the cover is filled by a thin sheet of packing to make it gas tight. The studs are from four to six in number. The water enters the jacket at *e*, and circulates around the cylinder and cover and passes out at *f*. It passes from the cylinder jacket to the head through the outside pipe, as shown, or through an opening directly upwards between the studs. The former method is preferable, as when the opening is cut in the packing there is liability of leakage and of water being drawn into the cylinder. Many engines have the cylinders and heads cast together, thus avoiding the joint; this saves all trouble with the circulating water and allows a rather more symmetrical head. It is, however, harder to examine and repair, as the cylinder, and sometimes a portion of the base, must be lifted to get at the working parts.

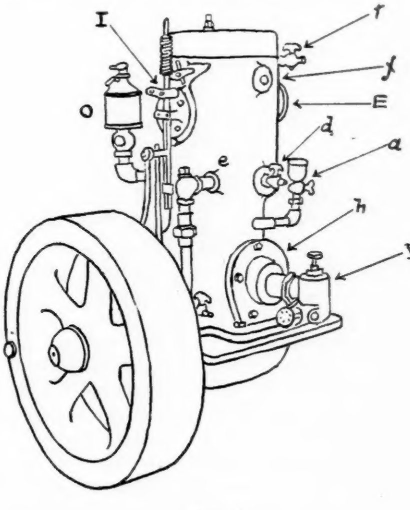


FIG. 9.

P is the piston; *r* the piston rings, usually three in number, which are set into grooves in the piston. They are turned to a diameter slightly larger than that of the cylinder and are sprung in, so that they press out against the walls of the cylinder and prevent leakage past the piston. The piston itself is a rather loose fit in the cylinder, and the rings are depended upon for tightness. Two of the rings are placed at the

top of the piston, and the other one at the lower edge; this is to prevent leakage from one part to another. For example, when the piston is a part of the way down the gas in the base might be forced up past the piston and out of the exhaust port, were it not for this lower ring. The joints in the rings are shown halved; they are often simply cut across at an angle; the former is the preferable method, as there is no chance for leakage. Piston and rings are of cast iron.

W is the wrist pin, or pivot, upon which the connecting rod swings; this pin may either be fast in the rod and turn in the piston, or *vice versa*, being held in place by a set screw. In some cases it is left entirely free to turn in both, but this is hardly advisable, as there is a chance of the end of the pin scoring the bore of the cylinder. The wrist pin is of steel.

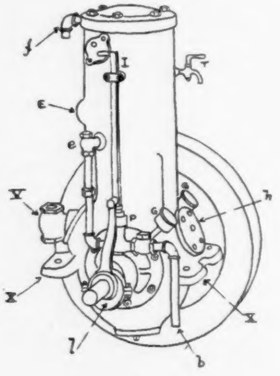


FIG. 10.

C is the connecting rod, of either steel or bronze; when of the latter metal, no inserted boxes are necessary, as the bronze and the steel pins will wear well together. The upper end of the rod consists simply of an eye, through which the wrist pin is inserted. The lower or crank pin end is cut, and the under portion of the bearing is fastened on with two bolts *g*; this is necessary in order to get it into place, and to allow a chance of adjustment to take up wear.

SS is the crank shaft, which should be made of the best of steel, as it is, perhaps, the most important part of the engine; the part encircled by the lower end of the connecting rod is called the crank. On the end of the crankshaft is the flywheel *F*, of cast iron; it is held in place by a key *K*, which is of rectangular section and is sunk half in the shaft and half in the hub of the flywheel, and prevents the flywheel turning on the shaft. The handle *t*, for use in starting the motor, is contained in a hole in the rim of the flywheel and is pulled out for use. It is encircled by a spring, which draws it in when it is released, and prevents injury to the operator.

The sleeves of composition *b b* which are inserted in the casting of the base, make a good bearing for the shaft. They not only make a better bearing than the cast iron of the base, but also allow of the insertion of new sleeves after wear has taken place.

P is the water pump, for circulating the water in the jacket: it is of the usual type of plunger pump, consisting of the plunger *L* working in the barrel. The plunger is made tight at the upper end of the barrel by the packing gland as shown, and at the lower end of the barrel are the usual two foot valves. The water is drawn in through one valve by the upward strokes, each valve allowing the water to pass in one direction only. The pump is operated by the eccentric *L* on the crank shaft, and the eccentric strap *M*, so that the pump has a stroke for each stroke of the piston.

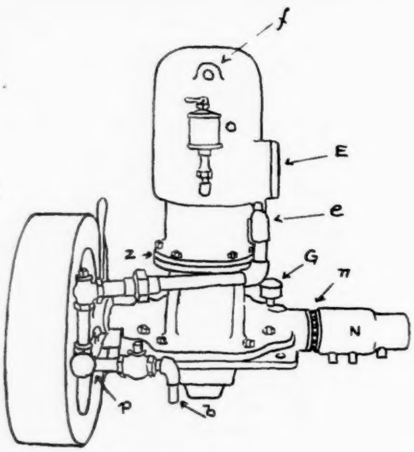


FIG. 11.

The thrust bearing, shown at *N*, takes up the forward thrust of the propeller and prevents the crankshaft being forced against the forward bearing by the pressure. It consists essentially of two hardened steel rings with steel balls running between them; the balls are held in a thin plate of composition and revolve freely.

N is the coupling by which the engine shaft is connected to the propeller shaft; it is a sleeve of cast iron, fastened to the shafts with set screws or keys.

At *d* is a pet cock, leading from the water jacket into the air; its purpose is to drain the water out of the jacket in cold weather, as the formation of the jacket is liable to split the casting. The opening at *t* also leads into the air and is provided with a pet cock for the purpose of relieving the compression when turning the engine over by hand.

I is the igniting mechanism, which will be described later.

G is a grease cup for lubricating the crankshaft bearing, a similar one being fitted to the forward bearing; it consists of a sort of cylindrical box with a screw and

cover and a stem leading down to the bearing. It is filled with grease, which is forced into the bearing by screwing down the cover. It is advisable to use the grease in these bearings, as it is thick and forms a film between the shaft and the bearing, which prevents leakage from the crank case.

At *O* is a lubricator for oiling the cylinder and piston; it may be considered simply as an oil reservoir for the present, as it will be described in detail later. The oil is delivered upon the bore of the cylinder and is distributed by the piston. The wrist pin is oiled by an axial hole, through which oil is received from the cylinder walls and delivered to the wrist pin. As a matter of fact, the wrist pin requires little lubrication, as the movement of the bearing around it is slight, otherwise the lubrication received in this way would not be sufficient. On the lower end of the connecting rod at *y*, is a small scoop, with a hole above it leading into the crank-pin bearing; the base is partially filled with oil. and a small amount is scooped up on each revolution and delivered to the crank-pin bearing.

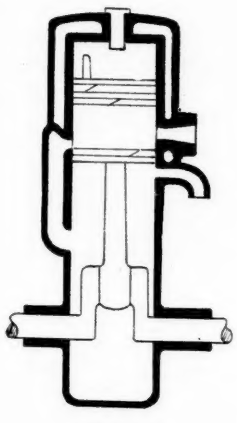


FIG. 12.

Fig. 9–10–11 represent the outlines of three standard makes of engine. In Fig. 9 the cylinder and upper portion of the base are in one casting, the lower part of the base and the cylinder cover being separate. At *n* is a removable cover over a hand hole leading into the base, allowing examination and adjustment of the crank-pin bearing. The gasoline vapor is delivered into the base through an opening in the cover plate *N* from the vaporizer *V* which will be described in detail later. The connection for the exhaust pipe is at *E*, on the rear of the engine. The water pump is just back of the flywheel and delivers water to the jacket through the pipe *e*; the water passes out of the jacket at *f*.

T is the compression cock, and *d* is the drain cock for draining the jacket. At *O* is the oil cup for oiling the piston and at *a* is cup and cock for introducing oil into the base.

I is the igniting gear, which will be explained in another chapter.

Fig. 10 is of the same general type, the letters referring to the same parts. In this type the cylinder and entire base are one casting, the main bearings being held in plates bolted on front and rear of the base. The water-pump and igniter in this case are on the rear of the engine, the pump drawing water from the outside through the pipe *b*, and discharging through the pipe *e* into the jacket; the cooling water flows out at *F* after circulating over the cylinder cover. *GG* are the grease cups for the main journals. *L* is the eccentric for operating the pump. *XX* are the flanges by which the engine is bolted in place.

Fig. 11 is of the type having cylinder and bead in one casting. The upper part of the base is a separate casting bolting on to the cylinder at Z; the lower part of the base bolts on below. The pump is horizontal, directly behind the flywheel, and discharges into the jacket through the pipe shown, *n* is the ball-thrust bearing, and *r* is the shaft coupling. *F* is the cooling water outlet, and *E* the exhaust outlet, as before. No igniter gear is shown, as with one method of ignition none is required.

While no two makes of motor have the same parts in exactly the same place, the above description should enable the reader to become familiar with the various working parts and the attachments, as all must have these parts in some form or other.

THREE PORT ENGINE.

A variation of the two cycle engine, known as the "three port" type, is illustrated by Fig. 12. The general characteristics and operation are the same as the regular two cycle type, with the exception of the meanes for admitting the vapor. Instead of the vapor being admitted through an opening in the side of the crankcase, a third port is provided, which opens into the cylinder just below the piston when the latter is at the top of its stroke; the carburettor is connected with this port. The piston covers this port except when it is at the top of its stroke, and at this time it is opened into the base.

The piston on its up stroke creates a partial vacuum in the base, and when the third port is uncovered at the top of the stroke, the vapor rushes in. The gas is thus admitted in a sort of puff instead of during the entire up stroke, as in the ordinary type, and is, therefore, more energetic and positive at high speeds. Since the piston covers the port except during the admission, a non return valve on the vapor inlet is not necessary, and the admission of vapor is less obstructed.

For these reasons the three port engine can be run at a higher rate of speed, and practically all engines intended to run at a speed greater than 500 revolutions per minute are now built on this principle. The external appearance is, with the above exception, the same as the ordinary two cycle engine.

INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

IV. Vibrators and Interruptors.

To secure the maximum efficiency of a coil it is essential that the vibrator or interrupter be exactly proportioned to primary current and service for which the coil is used. For small coils where simplicity of construction is desired, the ordinary spring vibrator is suitable, but careful designing and workmanship are quite important for even this type. A quick, snappy break means a stiff spring, but one too stiff will not be self starting. On the other hand, a very flexible spring will vibrate slowly, making it unsuitable for wireless telegraphy. Some experimenting with springs both as regards length and flexibility will be advisable to secure the one most suitable. In general, this type should only be used on coils giving less than a two inch spark.

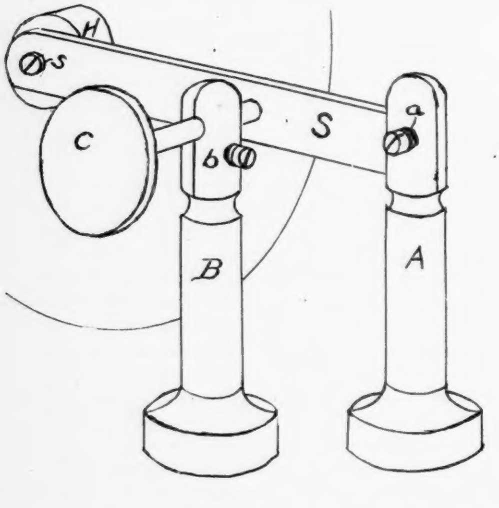


FIG. 1.

The design for a simple spring vibrator is shown in Fig. 1. The posts *A* and *B* are about ⅝ in. diameter, and high enough to bring the spring *S* in line with the core of the coil. For both rigidity and appearance the bases of the posts should be larger, or 1 in. diameter, but this is not absolutely necessary. Washers can be put under the heads of the screws which are used to fasten the post to the base, and the posts will be rigid if not too frequently adjusted. The top ot the post *A* is slotted with a fine hack-saw to receive the end of the spring *S*. A hole is drilled ⅜ in. from the top of the post *B* to receive the contact screw *C*, and the post is then slotted. A hole is then drilled through the post to receive the set screw *b* at right angles to the hole for the contact screw.

The spring *S* is of spring brass ½ to ⅝ in. wide, No. 30 to 24 gauge, and from 2½ to 3 in. long, these dimensions covering coils giving from ½ to 1½ in. sparks. A hole is drilled at one end to receive the screw *a*, and at the other end for the screw *s*, holding the hammer

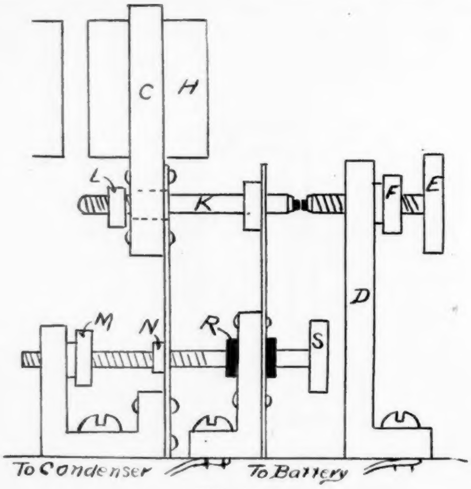


FIG. 2.

head. At the point where the contact screw *c* touches the spring, about midway between the post and hammer, a piece of sheet platinum is soldered, or a piece of platinum wire ⅛ in. diameter and 1-16 in. thick may be used. The contact screw should also have a platinum point. In soldering on the platinum, first clean the surface with a fine file or emery cloth; then with a blow-pipe or torch, melt a drop of hard brazing solder and, keeping the solder fluid with the torch, drop on the platinum and immediately remove the flame. Use only enough solder to firmly attach the platinum.

The contact screw *c* should be about 1½ in. long and 3-16 in. diameter, and have a large head at the outer end to facilitate fine adjustment. In testing the efficiency of vibrators, care must be used to learn if troubles arise from the vibrator, condenser, or weak or excessive currents in primary circuit, as the improper operation of the vibrator may result from any of these sources.

Another form of vibrator with a double spring has decided advantages over the one just described. From its action can be secured a long " make " and a short, quick " break, " thus obtaining thorough saturation of the core and a maximum spark. The rate of vibration can also be varied to a small extent. It is suitable for use with coils giving up to 8-in. spark, but a motor-driven, mercury-dip break is advised for coils giving a 4-in. spark, or over. The design of the double spring vibrator is shown in Fig. 2. The hammer *H*, is supported by a brass collar *C*, to which is riveted the spring *A*. The lower end of the spring is riveted to the U-shaped brass base, which is fastened to the wood base of the coil by a screw.

H. As the hammer moves towards the core with accelerating speed the collar *C* closes against the nut L, and forces the arm *K* to "break" from the contact screw *E*, which occurs just previous to the striking of the hammer against the core. The value of this design of vibrator arises from the momentum attained by the hammer before causing the break, which is quick and sharp. As the hammer recedes from the core after the " break " the contacts are quickly united and remain so until the hammer completes its swing, and again returns under the impulse of the spring *A*, and the attractive force of the core.

The two forms of vibrators described are suitable only when the variation of the vibrations is with-

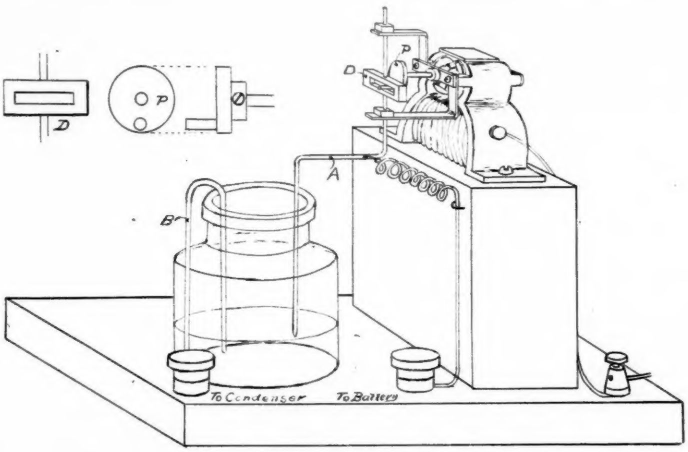


FIG. 2.

Near the lower end of the spring *A* is brazed a small nut *N*, which is threaded on the adjusting screw *S*. The end of the adjusting screw is threaded through a hole in the other arm of the brass base, and has a checknut *M* for binding fast when adjusted. A second spring *B* is riveted to an L-shaped spring base and has near the lower end a bushing of hard rubber *R*, fitting over the adjusting screw *S*. At the upper end is brazed a brass nut, which is used to more securely hold the arm *K*, one end of which projects to the front and is tipped with platinum, and the other end passes through a rather larger hole in the spring *A* and collar *C*, and is fitted with a threaded check nut *L*. The hole in the spring and collar should be large enough to prevent the arm from binding. The check nut *L* should fit tightly, and may also have a check nut outside for binding same to position.

The contact screw *E* is supported by the brass post *D* and has a check nut *F*. The end is tipped with platinum to prevent sparking. The platinum point of the arm *K* rests upon the platinum tip on the end of the contact screw *E*, which allows the primary current to flow around the core, thus attracting the hammer

in narrow limits. For experimental work or wireless telegraphy, where a wide range or a very rapid rate of vibrations is necessary they will not answer, and the motor driven mercury dip interrupter is more desirable. Such a device is not difficult to make, nor very expensive when made as shown in Fig. 3. An ordinary toy motor is mounted on a wooden block of suitable height, which in turn is supported upon a base board holding a short glass bottle with a wide mouth. Four binding posts are mounted, two on one side near the bottle, and two on the end nearest the block.

The motor is run by a battery of two dry cells and a rheostat is mounted on the outer surface of the block and connected into the motor battery circuit. By means of the varying resistances the speed of the motor can be varied over a wide range and adjusted to any required rate of interruptions for the coil. The bottle is partly filled with mercury, which is covered with a thin layer of turpentine or crude petroleum. The fixed lead *B* is a piece of heavy gauge copper wire running from one binding post, over the top of the bottle and into the mercury.

The vibrating terminal *A* is connected to the other binding post by a spiral of flexible wire, which is attached, at the outer end of the spiral, to the block holding the motor. This wire is soldered to the vibrator with soft solder to give good electrical contact. The movement of the vibrator is obtained by means of a brass box *D*, leaving a long slot which works on a stud put into the outer face of the small pulley on the motor. This stud is simply a short piece of brass wire, driven into a hole drilled in the pulley, or may be a round head, brass machine screw and the hole in the pulley threaded to receive it. The latter way is preferable, as the head of the screw serves to hold the box in position.

The upper and lower parts of the vibrator are brazed into holes drilled in the box. The box is cut out of a small piece of brass rod; the slot is formed by drilling holes and finishing with a small, flat file. The box and pulley are shown in enlarged view in Fig. 3. The vibrator should have a movement of about ⅜ in., and to obtain this it may be necessary to substitute for the motor pulley a disk of brass large enough to give room for the stud, which should be 3-16 in. from the center of the disk.

The bearings for the vibrator are made of strips of heavy brass, the ends of which are secured under the ends of the armature bearing on the motor. These strips are bent to an L shape, and holes are drilled in the outer ends to receive the vibrator with a sliding fit. To give a heavier bearing that will not quickly wear out, small brass discs are brazed over the holes, and bored out to a sliding fit for the vibrator. Graphite should be used as a lubricant for these bearings.

The vibrator is also given a short point at the end entering the mercury to prevent spattering. The duration of the "make" is regulated by the depth of the mercury; the greater depth the point enters the mercury, the longer the current flows through the primary. It is necessary that the point entirely clears the mercury on the up stroke, to ensure a good break· A little experimenting will quickly show the necessary adjustment. In place of changing the depth of mercury, alterations of the "make" can be obtained by placing pieces of cardboard under the bottle. To prevent the bottle from moving bore a shallow hole in the base board to hold it in place. This type of interrupter should not, for convenience sake, be mounted on the coil base, but may be made a separate fixture together with the condenser.

WHITE LEAD PAINT.

A great deal is said today of the adulteration of food products and drugs. Second only in importance are the frauds practiced in the paint trade. In point of magnitude they surpass the first. White lead, innocent of a trace of lead, is sold; one sample, bearing a label stating that $1000 would be paid if the lead in it was not pure, was found to contain no lead whatever.

The labor in painting is from two to four times the cost of the material. It is evident, therefore, that while the use of an adulterated paint works to the advantage of the painter, in that it makes frequent painting necessary, the house owner can ill afford any but the highest grade of materials. Many look only at the first cost, and imagine that a few dollars saved in the cost of the paint is so much money gained. This is due to ignorance.

The white pigments are of the most importance, as they form the basis of most paints and are often used for a first coat. Of these, white lead stands pre-eminent.

An easy test, requiring no chemical skill, is the blowpipe. A piece of close-grained charcoal is obtained, and in this a small hole is dug out. A fragment of the white lead, about the size of a small pea, is placed in this hole. With a common jeweller's blow-pipe a jet of flame is directed against the white lead, using the flame of the spirit lamp or a small gas flame. A pure white lead will melt down to a clean button of metallic lead, leaving no residue in the charcoal. The presence of adulterants will prevent this, and instead of getting a button a grayish white moss is obtained.

Another simple test is to treat the dry white lead with diluted nitric acid. If pure, it dissolves completely, with effervesence, to a clear liquid. If a lead in oil or mixed paint is to be examined, the oil should be first extracted by thinning down with benzine. The pigment settles to the bottom, and the benzine carrying the oil may poured off the top.

To cheapen white lead, barytes, whiting, terra alba, clay, silica, and zinc white are added. The latter, however, is said to prevent the chalking of lead. Any or all of these substances may be found in a mixed paint. The prudent buyer will do well to steer clear of mixed paints; he should purchase the proper ingredients and have the mixing done on the premises.

White lead may be bought absolutely pure in paste form, with 10 per cent of linseed oil. The manufacturers of white lead are not, as a rule, paint manufacturers, and if the lead is bought from the original maker, branded with his mark, there is no danger.

The paste lead is thinned with pure linseed oil; 5 to 10 per cent of a good light colored drier is added, together with the proper tinting material, and the mixture strained through a sieve before use. No turpentine or benzine is necessary.

An important saving can thus be effected. White lead is sold at a small margin of profit. The same is true of linseed oil, so that one who does his painting in this way is often able to find that he has obtained the best of materials at less than the cost of adulterated mixed paint, on which the manufacturer nets a large profit.—"Municipal Journal."

MAKING POCKET ACCUMULATORS.

BY "GEBON."

The following article on making pocket storage batteries or accumulators, is in reply to a correspondent who has asked for information on the subject.

Pocket accumulators are small cells measuring 4 in. from top to bottom, $3\frac{5}{8}$ in. from side to side, and $1\frac{5}{8}$ in. thick. The cases are made of sheet gutta-percha $\frac{1}{2}$ in. thick, or of sheet ebonite No. 14 gauge. They may be rectangular in shape with sharp corners, or curved to fit the pocket with rounded corners, the two forms being shown in full and dotted lines in Fig. 1. As gutta-percha is a material more easily worked than the ebonite, and the rectangular form easiest to make, this may first be tried.

If the cell is to be a 4-volt one, it must now be divided into two equal compartments by means of a vertical partition in the center.

To make this partition, cut a strip of the gutta-percha sheet, $3\frac{5}{8}$ in. long and 1 in. wide, to fit exactly the inside of the cell to within $\frac{1}{2}$ in. of the top, and then make all the seams tight with melted gutta percha. A cover, Fig. 2, must also be cut to fit in the top of the cell, and this must be perforated with four holes, two for the vent tubes *A*, Fig. 3, and two smaller end ones for the tangs *B* of the terminal.

The vent tubes are made of 1-in. lengths of ebonite tube. The top part of each tube is screwed to fit the

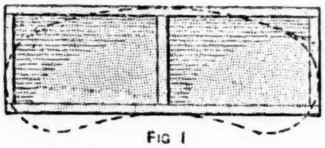


FIG 1

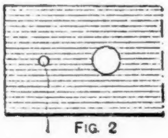


FIG 2

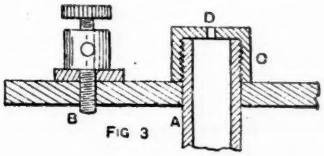
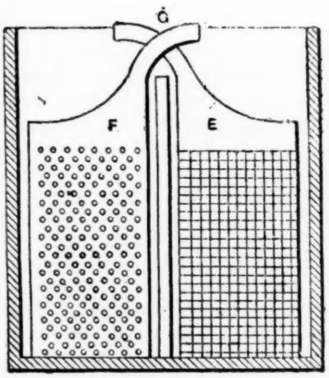


FIG 3



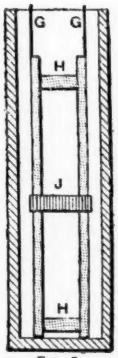


FIG. 5

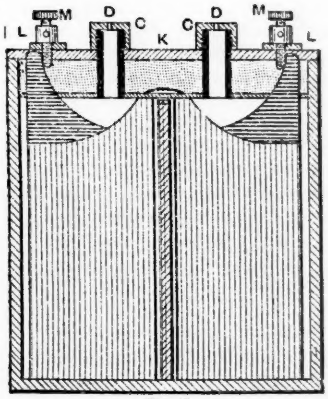


FIG. 6

First cut a wood block to the shape and size of the inside of the proposed coil, and smooth its surface. Next, get a sheet of gutta percha and cut from it a strip $9\frac{1}{2}$ in. long by $3\frac{3}{4}$ in. wide, to form the two sides. Put this over the outside of a vessel containing hot water, until the strip is soft and pliable, bend it over the wood block to the required shape, and put both under pressure until cold and hard. Then cut two strips of the same material, $3\frac{7}{8}$ in. long by 1 in. wide, to form the ends of the coil, and have them quite flat and straight with true edges. Fit three into the spaces at the end, press them close to the inside block, and melt some gutta-percha well into the seams to make the joints water-tight. This can be done with a hot iron.

inside of an ebonite cap *C* as shown in section at Fig. 3, and the top of this cap is pierced with a fine pin hole *D*. The lower part of the vent tube goes down into the top part of the cell, and is used to convey the acid charge into the cell while the cap is off. When the cell is charged and the cap screwed on, the pin hole in the top serves as a vent for the gas generated in the cell while working.

If the accumulator is to be of the curved form, it may be constructed as follows: Having first made a wooden curved core of the required size and shape, cut a strip of gutta percha $10\frac{1}{2}$ in. long and 4 in. wide, scarf the two ends, warm the strip as before, bend it round the wood core to the right shape, and close the

edges with a hot iron to make a sound joint. Then put the whole under pressure to keep the shape until cold. Then cut curved pieces for the bottom and the top, with the same arrangement for vent tubes and terminals as before.

The bottom piece must be fitted in and made water tight with gutta-percha, and the partition fitted in the center in the rectangular form. If an ebonite cell is preferred, the dimensions are as for a gutta percha cell, but ebonite will need more heat than gutta-percha to render it pliable. Powdered shellac is used in making the joints water-tight, these being kept hot and under pressure to force out excess melted shellac and to make a good joint. Ebonite makes a stiffer cell which does not alter its form when worn as gutta-percha does, but it is not so easily worked, and the joints present some difficulties in being made water-tight, even when melted shellac is used as a cement.

The lead plates forming the elements of the cells are of two kinds, positive and negative, the first being coated with peroxide of lead, and the latter with finely divided lead. These plates are really grids of lead, the holes being filled with the required pastes. The grids may be made by hand as follows: Procure some sheet lead 1-16 in. thick, and cut from it four strips 7½ in. long by 1½ in. wide. Mark off 6½ in. on each of these strips, and rule the surface with ⅛-in. squares. Then punch or drill a ⅛ in. hole in each square, and countersink both sides of the holes.

Now take some red lead in a saucer and make it into a stiff paste with equal parts of sulphuric acid and water, using a spatula for mixing. Lay two of the lead strips on a sheet of thick glass and cover all the holes with a layer of the lead paste well pressed in with the spatula. Then turn up 3¼ in. of each plate and bend over the other 3¼ in. to form a double plate with the paste inside. Press the two sides close together, scrape off the exuding paste, and coat the outsides with a layer of the paste, again pressing it well into the countersunk mouths of the holes. Then set the pasted plates in a warm place for fifteen hours to dry and harden. Meanwhile, make a strong solution of chloride of lime in rainwater and set aside to settle and clear. When the plates are dry and hard they will have a grayish-brown appearance and must now be immersed in the clear chloride of lime solution until the color changes from brown to puce, that is, until the sulphate of lead and red-lead have changed to peroxide of lead.

The plates must now be gently rinsed in clean water and they are then ready to put into the cells. The two other plates should be coated with a paste made of finely divided lead in water in a similar manner, but will not require the process of "forming" in chloride of lime. The finely divided lead is prepared from acetate of lead (sugar of lead) in the following manner. Make a strong solution of sugar of lead in distilled water, and in it suspend some pieces of clean zinc, which will separate the lead in small flakes. When all action ceases and all the lead is extracted, pour away the liquid and well wash the lead flakes in water. Drain off all excess water, leaving enough to form a stiff paste, which is then used to paste the negative plates, and they are placed in the coils while still wet.

It will have been noticed that 1¼ in. of single blank lead strip is left on each plate. These blanks are left to form the lugs or connections between the plates of adjoining cells and connections to the terminals. These connections need only be ¼ in. wide; the remainder can be cut off, making each plate of the form shown at Fig. 1. The plates are to be put in the cells with a positive on one side and a negative opposite, as at *E* and *F*, the positive in one cell being on the same side as the negative in the next cell, to which it must be connected by soldering together their two lugs *G* over the partition dividing the two cells.

Before doing this, the plates should be placed together, with a thin strip of ebonite *H*, Fig. 5, separating each pair, a rubber band holding all firmly. Each pair can then be slipped into their compartments and connected. Then cut an inside cover, similar to the outside cover, for the cells from a thin strip of ebonite. Lay this on top of the plates, put in the vent tubes *C*, Fig. 6, and fill up the space between the outer and inner covers with melted marine glue to seal the cells nearly water tight.

The top cover *K* must now be fixed. First note the marks on the five lugs of the plates on each side, and make corresponding marks on the ends of the cell, to distinguish the position of the positive and negative plates inside the cell. Bring the lugs *G* up through narrow slits in the cover, and solder them to small thin brass nuts, through which the tangs or terminals *M* will pass into the small holes in the cover. Then, on top of these nuts place ebonite collars, and screw down the terminals firmly. Next press the cover down into its place, flush with the top of the cell, and secure it with melted gutta-percha round the edges. The completed arrangement is shown in the section by Fig. 6.

The cells must now be filled and charged. They are filled through the vent tubes with a solution of sulphuric acid in water, made by adding in a thin stream 5 parts by measure of strong sulphuric acid to 31 parts of water. This mixture should be put into the cells when cold. They are charged by sending a continuous current of ¼ ampere through the two cells at a pressure of 5 volts during a period of four hours. If a primary battery is used to furnish the charging current, three bichromate cells should be employed and the carbon plates connected to the positive terminal of the accumulator. It is advisable to have an ammeter in circuit with the cell while being charged, and also to employ resistance to keep the current down to a ¼ ampere, since injury may be wrought to the plates by a higher rate of charge. This should also be done if the current is obtained from a dynamo.

The following hints may be useful in making and working pocket accumulators: The holes in the grids

may be of any shape. When many grids are required, it is advisable to cast them in plaster-of-Paris moulds, as the hand punch method is tedious. In charging the cells, no injury can follow prolonged charing a low low rate, but much damage can be done from a short charging at a high rate. Cells should never be run down entirely, nor put aside uncharged. They should always be fully charged before they are placed in store, and frequently recharged while in store. Jolting and shaking tend to injure the plates, so also does short-circuiting the cells, as by spanning the terminal with a short wire. The E. M. P. of each cell should be 2 volts, and if it falls below this the cells should be recharged.—"Work," London.

HIGH SPEED LAUNCH.

[Continued from Page 230.]

every revolution and add friction. The engine, after being lined up, is fastened down with lag screws. The propeller will probably come fitted to the shaft, so that all that should be necessary is to put propeller in place on shaft and fasten with either nut or pin, as is provided. The propeller, when in its proper place, should should be 10 in. from the point of stern to center of propeller, and the inboard end of the shaft is cut off to bring the propeller in the proper place.

The propeller strut is shaped as in Fig. 13, from a piece of flat brass 1 x ½ in. It is bent to the shape shown, of sufficient depth to suit the shaft and with a spread of about 6 in. For the bearing a piece of extra thick brass tube which is a running fit for the shaft, can be used. It is fitted into the eye and soldered in place. The strut is then adjusted until the bearing is free on the shaft and the arms have a good bearing on the hull, and it is then fastened in place with two copper rivets in each arm. If the rivets cannot be made to come through a frame, a piece of oak should be put inside to take them.

The gland on the after end of the skeg is fitted in place with plenty of thick paint underneath to make it water tight.

An additional bearing should be arranged about half way between the engine and the stuffing box; it can be made of a piece of extra heavy brass tube, the same as the strut bearing and secured in a wooden block. When all is set up and made tight, the engine should turn over freely and easily, otherwise there will be undue friction and the full power of the engine will not be realized.

The engine selected for use should be of 1½ to 2 h. p., of high speed type, and should not, for best results, weigh over 80 pounds complete with pump.

The installation is made in the usual manner according to the directions which accompany each engine, or can be obtained from the engine makers on request. The gasoline tank should hold about five gallons and be located under the forward deck, supported by straps from the deck above, as in Fig. 5.

The filling pipes for the tank should extend through the deck with a screw cap. The connection from the tank to the engine is ¼ in. pipe size, lead pipe, with a stop cock near the vaporizer.

A fixture of much value is a sediment trap quite near the tank, made by fitting a brass T to the tank and to the lower end of the T fitting a coupling and plug. Any sediment from the tank will collect in the neck having the plug, which can be removed at times when the tank is nearly empty.

The exhaust pipe should pass through the muffler and then directly outboard through the side of the boat. A brass collar is fitted to cover the edges of the canvas around the hole. The suction to the water pump must be below the water line, with a brass strainer over the end to prevent weeds or sand from being sucked into the pump; the discharge from the engine may be above water.

The batteries and spark coil are located in a box under the forward deck, as it is very essential that they should be kept dry; the switch is located on the side of the boat opposite the engine.

The steering gear may be arranged as shown, with an automobile type wheel steerer, or may consist simply of the usual wheel with ropes running around the cockpit with a block at the forward end, two blocks on the deck opposite the tiller, and a few screw eyes between. The cleats and chocks, backboard for the rear seat, and other furnishings are fitted to suit the builder.

In all this work it must be borne in mind that lightness and strength are necessary for success, and everything should be done with this end in view, and as little extra material added as possible.

The final painting and finishing is now to be done; when the final coat is put on the boat should be entirely smooth, with no sign of the grain of the cloth; the final coat may be of enamel paint, giving a glossy appearance. When well constrncted the boat will present a very ornamental appearance.

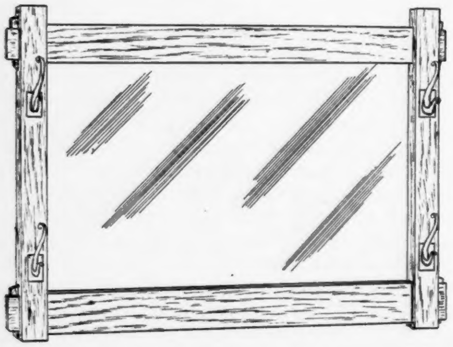
In handling this boat it must be remembered that it is of light construction and must be carefully handled, and when so treated it will be very durable. It should not be left afloat for long periods, and should be kept in a boat house under cover, if possible; this should be readily done on account of its light weight. It will, however, be found to be very satisfactory for the purposes for which it is intended.

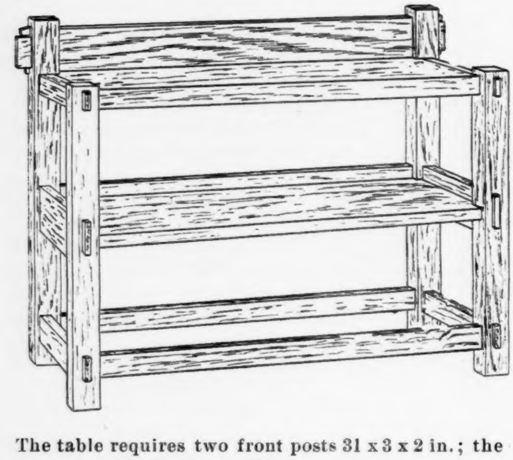
The term circular mills, which is often used for designating the size of large wires and cables is obtained by squaring the diameter in mills, a mill being one-thousandth of an inch. To reduce circular mills to square inches, divide by 1,000,000,000 and multiply by 0.7854.

HALL TABLE AND MIRROR.

JOHN F. ADAMS.

The hall table and mirror here described, are in the "Mission" style, and are given at this time as they are particularly suitable for summer residences. Those readers who are fortunate enough to possess the luxury of a summer place and have the leisure for cabinet work, will have no difficulty in constructing either of these pieces of furniture. They are equally suitable for other than summer houses, and can be kept in mind for winter work by those who find the design suitable for their needs.





The table requires two front posts 31 x 3 x 2 in.; the rear ones are 35 in. long. The cross pieces from front to rear posts are 19 in. long, which allows ½ in. at the rear ends for tenons, and 3 in. at the front ends. The distance between the front and rear posts is 16 in, and between the two front posts 39 in. The upper cross pieces at the ends are 2 in wide, the middle one 4 in. wide, and the lower one 2½ in. wide; all are 1¼ in thick. The space between upper and middle cross pieces is 10 in.; between the middle and lower ones, 8 in. The tenons on the ends are ¾ in. wide; those projecting at the front being bevelled slightly to take off the sharp edges.

The lower pieces connecting the two front and two rear posts are 40½ in. long, 2 in. wide and 1½ in thick, allowing ¾ in. at each end for tenons. The pieces are 2 in. above the floor. The lower shelf is 41 in. long, 17 in. wide and 1¼ in. thick. At the back edge is a piece 40½ in. long, 3 in. wide and 1 in. thick, mortised into the posts, and with the lower ends flush with the under side of the shelf. The corners of the shelf are cut out to fit around the posts and the shelf nailed in place when finally assembled.

The cross piece at the back of the top shelf is 50 in. long, 7 in. wide and 1 in. thick. The tenons on the ends are 3 in. wide and ¾ in. thick. The wedges and mortises for same are ¼ in. thick. Care must be taken in cutting the mortises to prevent breaking the ends, and to get them correctly located. The top shelf is in two thicknesses, using stock ⅞ in. thick. A front finish piece 2 in. wide and ⅞ or 1 in. thick is nailed and glued to the front edge, planing down smooth after the glue is hard.

The mirror frame is for a mirror 24 x 40 in., making the inside dimensions of the frame 23¼ x 39¼ in. The two end pieces are 33 in. long, 3 in. wide, and 1¼ in. thick. The top piece is 50 in. long, 3 in. wide and 1 in. thick. The lower piece is 50 in. long, 4 in. wide and 1 in. thick. The mortises on the ends of the top piece are 2½ in. wide, ⅞ in. thick and with ¼ in. mortises for the wedges. The mortises on the lower piece are 3 in. wide, ⅞ in thick and with ¼ in. mortises for the wedges.

On the inner edges of sides and cross pieces cut rabbets ⅝ in. deep and ⅝ wide for receiving the mirror and backing for same. Care must be taken in cutting the mortises to have them well made, otherwise the frame will not be firm enough to hold the mirror, which is rather heavy. Four ornamental hooks are hung as shown; two on each side piece. Brass plates are attached to the back for holding to the wall with screws. The wood used for both table and mirror frame should be oak, stained dark as desirod, and given a wax finish.

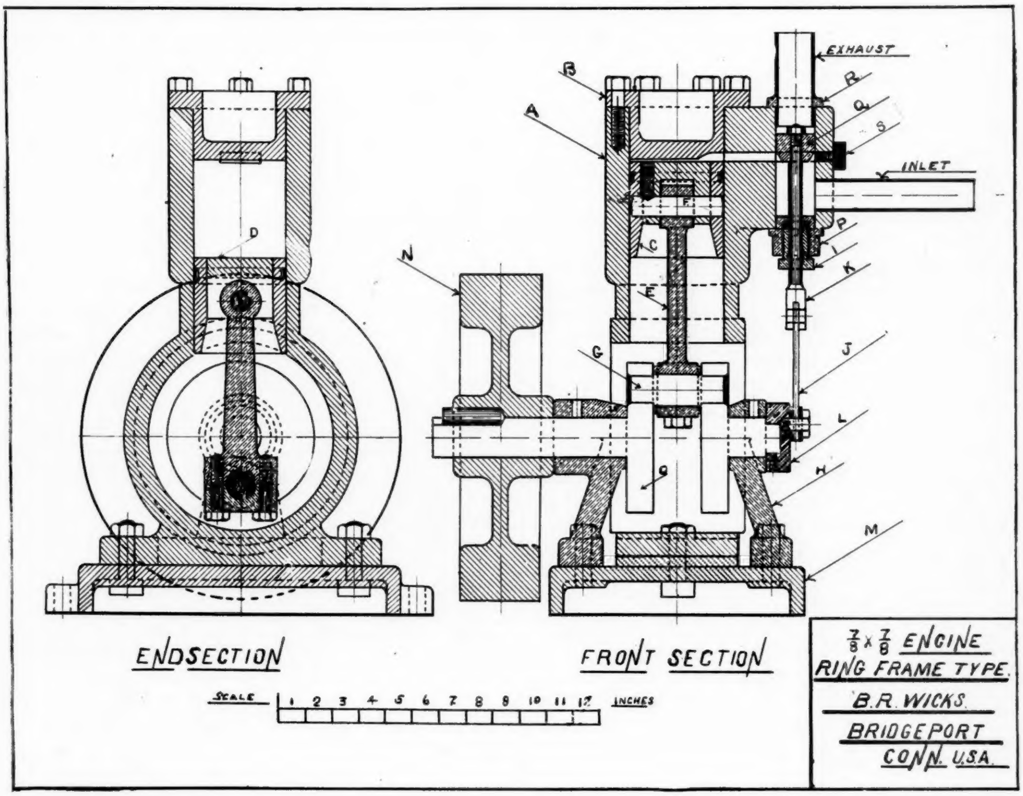
The per capita of money in circulation on May 1 was $31.22 for each inhabitant. That exceeds the record of any previous time. Most of the gain was in gold, $30,000,000 being added by imports, and gold certificates also gained about $11,000,000.

MODEL HIGH SPEED ENGINE.

B. R. WICKS.

The engine here described is especially designed for the benefit of the amateur who wishes to construct a simple working steam engine with his own tools.

This engine comes under a new name in the small engine field. It is called the ring frame, single acting, high speed, center crank steam engine, with piston valve and crank eccentric in place of the usual type of eccentric and eccentric strap. The crank eccentric and piston valve is used on this engine to avoid friction. Under this system the engine will be able to give from 1000 to 2000 r. p. m., and develop from 1-20 to ½ h. p. according to the boiler pressure used.



All the machine work to be done on the castings can be done in the lathe, as there is no planer work on the engine. A lathe that will swing four inches and has a slide rest, will do the job. A few drills, reamers, taps and dies will have to be used, but very few.

The design and construction has been made as simple as possible. The drawings show the front and end sections. The various parts are lettered for clearness in distinguishing the parts to be used in the construction, one from the other. *A* is the cylinder, valve chest and frame cast in one piece.

The machinery operations on the castings are as follows: The bottom is held in the vise and filed off true, then bolted to the lathe face plate, trued up by the outside of the casting and bored and reamed out to ⅞ in. standard. The ⅞ in bore must be a perfectly straight and smooth hole. When in position, face off the top of the cylinder.

The ⅜ hole for the valve chest is now to be drilled and reamed. Lay out the center of the valve chest 1 3-32 in. from the center of the cylinder and drill with a drill slightly under ⅜ in. and finish with a ⅜ in. reamer.

The ⅜ in. bore of the valve chest is tapped with a 7-16–32 V thread tap, 3-16 in. deep for the exhaust pipe bushing, and the bottom faced off with a small fly cutter on a ⅜ in. bar, so that the valve rod stuffing box *P*

will set flush when in position.

The cylinder cover *B* is finished all over and can be done in a three jawed chuck to good advantage. A bolt circle must be made with a sharp pointed tool on the side that goes next to the cylinder. Lay out the circle in six equal parts. Notice the location of the cut out for the steam port. Drill the six holes with an N 28 drill.

The steam port is laid out, drilled and filed out to 3-32 in. wide and ⅜ in. long. The steam drill inlet boss is drilled and tapped with a 1-4-32 thread. Also drill two 5-32 holes in the bottom as shown in the drawings, for holding the frame *A* in position on bed *M*. The piston shell *C* is bored out in the chuck, finished up between centers and faced to length, and the groove for the piston ring cut in. The piston must be a good fit in the cylinder, without the least shake.

The first piston plug *D* is held in the chuck and finished all over at one setting, so that it will tap in the piston shell *C*. The slot for the connecting rod is milled out.

The piston ring is made of steel, bored and turned in the chuck, cut off and fitted to the groove in the piston shell, then cut at an angle of 45° with a fine hack saw. Finish out with a file and spring into the groove in the piston shell. But putting the ring in position will be left till the assembling operations. The shell *C* and plug *D* are placed in position, and the 3-16 in. hole for the wrist pin *F* drilled and reamed. The wrist pin and the slot for the connecting rod must be exactly square so that the head of the connecting rod *E* will not bind and cause friction.

The ⅛ set screw holds all three, *C*, *D* and *F* in position. *F* is the wrist pin, made of 3 16 in. Stubs steel, and requires no turning. The connecting rod *E* is one universally used, and the machining operation is so simple that it will not be described. The two crank discs and shaft are made in one piece from steel.

They are turned between centers and finished both the same size. The hole for the crank pin *G* must be exactly the same in both pieces from the center; these should be drilled and reamed together to insure that these holes match. The crank pin *G* is turned between centers; the ends that fit the discs must drive and be left about 1-32 in. long, to allow for rivetting. The right hand shaft is turned smaller for the crank eccentric *L* to fit on the end.

The bottom of the two main bearings *H* are faced off between centers, mounted on a small angle plate and bored out, reamed to ⅜ in. and faced to width on a ⅜ in. mandrel. Drill two holes in the bottom of each of the main bearings to hold them in position on the bed *M*. The bed *M* is strapped to the face plates and the top faced off. The fly wheel *N* is bored out and reamed to ⅜ in. diameter and finished on a ⅜ in. mandrel between centers.

The crank eccentric *L* is to be made from steel. It is chucked and bored out to fit snugly on the ¼ in. diameter end of the crank shaft, with a small square pointed tool. A piece of 5-16 in. steel rod is held in the chuck and turned to fit the ¼ in. hole as a mandrel, and turned on all the surfaces and polished at one setting. Lay out the stroke of the eccentric ⅛ in. from the center and drill with a 6-64 in. tap drill and tap out with a 9-64-32 thread. The eccentric is held in position on the shaft with a 1-16 in. jib screw.

The valve rod *K* is made from 3-16 x ¼ in. cold rolled steel, turned between centers, threaded on the top end for a 7-64 in. nut to hold the valve *Q* in position. The bottom end is slotted to receive the eccentric rod *J*. A ⅛ in. hole is drilled for a ⅛ in. bolt to hold the two together.

The valve rod *I* is drilled and reamed to ⅛ in. diameter, and threaded with ¼-32 thread, to screw in the valve rod stuffing box *P*. *P* is the valve rod stuffing box. All the machinery operation is done at one setting in the chuck. and it is to be sweated into the ⅜ in. bore of the valve chest.

The valve *Q* is drilled, reamed and finished in the chuck. It should be ground with ground glass and oil to make a steam-tight sliding fit. *P* is the exhaust bushing. This must be turned on a mandrel, tapped the size for a 5-16-32 thread, turned and a 7-16-32 thread cut on one end 3 16 in. long, to fit the top of the valve chest.

The mandrel can now be forced out and the bushing be screwed in position in the valve chest, and the hole formerly occupied by the mandrel tapped out 5-16-32, V thread for the exhaust pipe. The eccentric red *J* is filed out of 1-16 in. sheet steel, drilled and reamed on the eccentric end to 5-32 in. and the valve-rod end ⅛ in.

Two brass washers are required 5-16 in. diameter and 1-32 in. thick, one between the eccentric rod and crank eccentric, and one on the outside. The peep hole cover is made by pouring babbitt surrounded by fire clay and fastened to the outside with two 1-16 in. screws not shown in the drawing.

In assembling the various parts, see that there are no burrs in the cylinder or valve chest, or any working part. As all the parts have a letter given on the drawings, the builder will have no trouble in locating the parts as they are to be assembled.

An advantage as a steam raising fuel possessed by oil as compared with coal is the remarkably steady steam pressure which may be obtained by means of the liquid fuel. This is due to the fact that the oil fires do not require the periodical, and automatic logs of steam pressures on ships using oil as fuel can easily be made to show as little as two pounds maximum variation of pressure for a run of 27 hours or more. This of course, conduce to economy in the operation of the boiler, which is under conditions that are kept constant, insteadof having the 30 per cent drop in pressure which is sometimes noted on an overloaded boiler when it is found necessary to clean the fires.

BOOKS RECEIVED.

20th CENTURY MACHINE SHOP PRACTICE. L. Elliott Brooks. 631 pp. $7\frac{3}{4}$ x $5\frac{1}{4}$ in. 423 illustrations. Price $2.50. Frederick J. Drake & Co., Chicago, Ill.

The author, in compiling this book, certainly desired to make it a complete handbook for the beginner in shop work, as the first quarter of the book is taken up by chapters devoted to arithmetic, geometry, mensuration, applied mechanics, properties of steam and horse power. Had much of this matter been omitted, and the space been given to a more amplified treatment of the main subject, a more useful book would have resulted. For the above reason the remaining chapters are barely more than descriptions of tools, with but little attention to their application to common shop processes.

This is illustrated by the subject "Taps," to which less than eleven lines are given, which can hardly be termed an adequate treatment. On the other hand, owing to the condensed treatment, nearly every hand and machine tool in general use is mentioned, and most of them illustrated. Anyone desiring a handbook of present day tools would find the book useful.

THE SIGNIST'S BOOK OF MODERN ALPHABETS. F. Delamotte. 101 plates 9 x 6 in. Price $1.50. Frederick J. Drake & Co., Chicago, Ill.

The styles of letters shown are of far more value to the artist or engraver than to the sign painter or draftsman, very few being adapted for use by the latter classes. As over a hundred different styles of letters are given, there is ample variety to select from by those who have need of ornamental designs.

PICTORIAL COMPOSITION. Prof. A. G. Marshall. 61 pp. 10 x $6\frac{1}{2}$ in. 180 illustrations. Price $1.00. Photo-American Publishing Co., Stamford, Conn.

If copies of this book could be placed in the hands of every photographer, artist and critic in the country, a wonderful amount of good would follow. It requires but a casual inspection to show the thoroughness with which this subject, so vital to good photographic work, has been treated. A great deal of space could be taken in mentioning the many excellent parts of the book, but all could be summed up in the statement that it is invaluable to all who desire to know the principles of composition. The low price places it within the reach of all.

CORRESPONDENCE.

No. 148. MARBASS, N. D., APRIL 29, 1906.

Will you please tell me what size of wire to use and the amount in the primary and secondary windings for an induction coil to give a one-half inch spark? Would a condenser be necessary? If so, how is one made? Where can the tinfoil for Leyden jars be obtained? E. D. C.

Specifications for many sizes of coils, including one half-inch spark, are given in the Oct., 1905, number of this magazine. For secondary windings, No. 36 B. & S. gauge single cotton covered wire may be used if extra care is taken in applying insulating wax. A condenser is necessary. Directions for making are given in June. 1906, number. See our premium offer for tin foil.

No. 149. SAN DIEGO, CAL., APRIL. 29, 1906.

Will you please answer the following questions through the correspondence columns: Could the amateur runabout described in the March, 1905, number AMATEUR WORK, be made by a boy 12 years of age, if the iron work was bought ready made and finished? Where could these parts be obtained? Is there any place where I can obtain the parts of runabouts ready to put together? H. S.

Age has less to do with making a runabout, or any other equally complicated machine, than has mechanical skill and experience. Our experience in this matter, and considerable time has been spent in investigating the subject, leads us to the conclusion that it is much more satisfactory to watch the advertising columns of the Sunday papers published in the larger cities, and buy a second-hand car, when a good trade offers, rather than attempt to make one. The agencies of standard makes of machines frequently have to take small cars, and such second-hand cars are sold at low prices. The difficulty, even in the largest cities, of obtaining certain parts, makes the expense of constructing a car great enough to nearly offset the saving in making one. Damaged cars can frequently be bought at very low prices, and a good mechanic can make the repairs necessary at a small expense. As conditions now are, the making of a car cannot be recommended.

No. 150. BUFFALO, N. Y.. APRIL 29, 1906.

I have a dynamo that gives 35-40 volts and 3 amperes. The armature is wound with No. 20 single covered magnet wire. I wish to increase the amperes and lower the voltage about 10 volts, but without changing the wiring on the armature, if I can. How many storage batteries can I charge with a current at 20 volts. J. P

It will be necessary to rewind the armature to obtain an equivalent output to that at present, at the same speed. Use No. 18 gauge wire, and at a slight increase in speed you will get about 25 volts and 5 amperes. You can charge 8 cells of a storage battery with a current at 20 volts.

No. 151. NEWTON, ILL., MAY 18, 1606.

I have a 1-12 h. p. motor on my peanut roaster, and the current for running the motor is supplied by a battery of 12 dry cells. Will a spark coil strengthen the battery, or what will give me a greater current? Please tell me the use of a condenser. G. W. H.

A spark coil transforms the current from a low voltage and large amperage to high voltage and low amperage, with slight losses in the operation. Introducing a spark coil into the battery circuit would be a positive detriment, as the current from the coil would not be suitable for running the motor, You need a different type of battery; one giving a large, steady current on closed circuit, as the motor is probably in use so much of the time that the dry batteries polarize more or less, and consequently do not properly run the motor.

If the expense and weight are not objectionable, accumulators would be the most suitable, and they could be recharged at the lighting station at such times in the day as they are not in use. If facilities for recharging are not convenient, get Edison-Leland, or some similar type of battery, or make a bichromate battery, as described in the June, 1904, number of this magazine. The objection to the latter form of battery is that the zincs must is be removed when the battery is not in use, as action continues whether a current is being taken off or not, so long as the zincs remain in the solution. The function of condensers is fully described in the May, 1906, number.

No. 152. BUFFALO, N. Y., MAY 14, 1906.

Will you kindly answer the following questions regarding the "Telegraph Recorder" described in the Sept., 1904, copy of AMATEUR WORK; Would the works of an ordinary alarm clock be strong enough to move the tape? Where can I purchase a small pen of the kind used on paper ruling machines? Will you kindly give directions for making the trip to be used on the clock gear? Kindly mention the name of some firm from whom I may purchase a length of Wollaston wire as used in electrolytic receivers. W. H. C.

The works of an ordinary alarm clock, if in good condition and not of too small a size, will move the tape without trouble. The ruling pen can be purchased of any ruling firm in your city. Ask any stationer where ruling is done, and apply at the address given. An article describing a trip for the clock will be published as soon as prepared. We know of no firm where Wollaston wire can be purchased at retail. As an accommodation we will send you three feet of .002 gauge wire from our own supply for 25 cents.

No. 153. PROVIDENCE, R. I., MAY 14, 1906.

Will you please inform me of a quick drying varnish which can be used to protect steel during the process of etching names. H. D.

Asphaltum varnish is the kind generally used for the purpose named. Paraffine wax can also be used, the latter being more easily worked when marking out the letters.

SCIENCE AND INDUSTRY.

Up to 1840 there were no iron bridges in the United States except suspension bridges, in which iron links were used in the cables and suspenders, the floor system being of wood. The first bridge in America consisting of iron throughout was built in 1840 by Earl Trumbull over the Erie Canal, in the village of Frankfort, N. Y.

The drill frequently penetrates hundreds of feet of solid salt in drilling wells for petroleum. The salt is often as clear as glass, as hard as rock and is frequently intensified with shale, as is freqnently the case with coal. In the region where there is a stratum of salt above the petroleum there is often salt water in the petroleum stratum. Especially is this the case where the material between the surface and the oil stratum is mainly limestone. The latter material, being very unyielding, its cleavage allows an easy access of water, often to a great depth; while clayey shales, being more plastic, often exclude all water from penetrating more than a hundred feet or so from the surface.

Francis J. McCarty, a 17-year-old San Francisco youth, believes that he has discovered the secret of transmitting the sounds of the human voice through the air without the aid of wires. It is said that experments made on the ocean beach with apparatus went far to prove that the problem of wireless telephony is solvable, if not actually solved already.

That the phonograph is a popular means of entertainment is obvious to everybody's ear, but few will fail to be surprised at the fact that the output of Edison records last year was fourteen millions. The company is now forty thousand machines behind its orders.

Many, many years ago, salt was so hard to obtain, but so necessary to have, that Roman soldiers were paid part of their wages in salt. Now, the Latin word for salt is sal, and from that came the word salarium, meaning salt money. Finally the soldiers were paid only in money, but the term salarium was still used to designate these wages. From this old Latin word comes our English word salary. Do you see, then, why we say of a worthless fellow that he "is not worth his salt?"

In answering the question, "How soon will electricity replace steam as the motive power of steam railroads?" it must be remembered, says the "Railway Critic," that electricity only shows an economy over steam locomotives under certain special conditions, among which are those that the distance should be comparatively short and the traffic dense. During the next few years we are likely to see the adoption of electricity as a motive power in tne railroad terminals of the great cities, and, perhaps, between some of the great cities, such as between New York and Philiadelphia, but the bulk of the long-distance hauling and and the freight traffic is likely to be done by steam locomotives for some time to come.